

# **NAVAL POSTGRADUATE SCHOOL**

## **Monterey, California**



### **THESIS**

#### **IMPLEMENTING AN INTRANET-BASED PERSONNEL DATA SYSTEM IN COMBAT ARM SCHOOLS**

by

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March 2000

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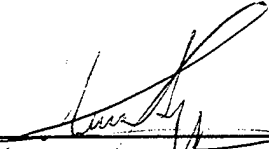
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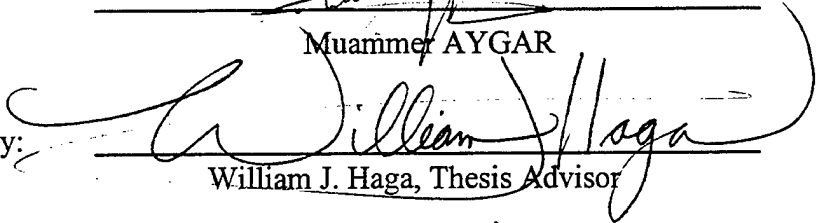
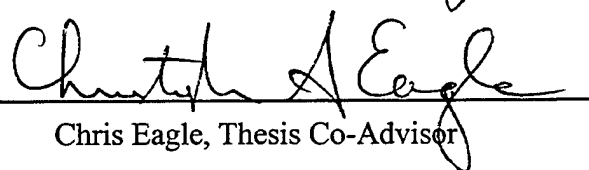
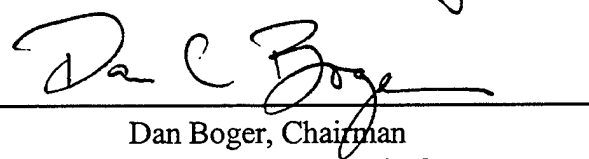
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## **ABSTRACT**

This thesis presents a model of intranet implementation for a military organization. The model includes the design and implementation of a relational database for personnel department which is connected to the intranet. The database connectivity from back-end to front-end constructed by Active Server Pages (ASP), enables the users to manipulate the database via their web browsers. From the technical aspect, in order to achieve a successful and secure intranet implementation, several software and hardware components are reviewed and some are recommended. The intranet pages are built with Microsoft Front Page 98. This prototype will be a first and big step for this organization to initiate a transformation from the traditional manual world to a digitized world. Therefore, it is highly expected that there will be a change problem in the organization. From the management aspect, specific change strategies are suggested to manage change.

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## I. INTRODUCTION

Tell me Lieutenant, why should I accept this intranet thing?, convince me. Well, Sir, as you will read in my thesis, there are lots of benefits of having an intranet in an organization. First of all.....

The statements above will probably be the first sentences of a conversation held between the Air Defense Artillery (ADA) School Commander and the author when he goes back to his country after a two year education at the Naval Postgraduate School (NPS).

This thesis will analyze the usage of intranets in organizations and implement an intranet prototype for Air Defense Artillery (ADA) School in Turkey.

ADA school was established in 1997 and shortly after the establishment it moved to a new location in Istanbul, which is the largest city in Turkey. It is a mid-sized military organization, which supplies a variety of services with approximately three thousand personnel. More information about the school and its organizational structure will be given in the later chapters.

The prototype application will not have all the contents that ADA School requires, however it will draw a frame and build a main structure for future applications.

The implementation of this intranet prototype will not only be a technical innovation for the school but also will render a change in the organization culture. Therefore this thesis will refer to the management side of implementing an intranet, in addition to the technical aspects.

The main idea behind this prototype is to enable ADA School personnel to communicate with each other better, faster and cheaper. All the necessary information will be shared and every sub-component of the school will be networked to each other. All kinds of forms and periodic reports will be published on the intranet. Thus there will be savings in paper cost, human resources and time. The workload of the headquarters of the school and the sub components will be lessened and they will have more time for working on strategic issues rather than dealing with ordinary processes.

There will be various applications such as a phone book, a visual aircraft recognition site and homepages for sub components. More important than those, the heart of the ADA School intranet will be a personnel database that can be accessed by everyone, in accordance with their access permissions.

Currently the school has a stand-alone personnel database to which only a couple of users can access. This prototype will design and implement a relational database for personnel department and connect it to the intranet by using the middleware, Active Server Pages (ASP) technology. The users will be able to manipulate the database such as entering new data or updating the existing data via forms, viewing reports and making queries. These are some of the benefits of having an intranet.

On the other hand, besides these benefits, there will be some pitfalls such as potential for chaos, security risks, information overload and negative productivity.

In addition to that failure is part of the life in software world. According to a survey done by Standish Group, 91% of the software projects in large companies in United States fail. (<http://standishgroup.com/visitor/chaos.htm>). So, while implementing software projects, expectations should be realistic.

The author believes that the pros outweigh the cons and it is worth having an intranet for ADA School.

As the Internet and intranet have many common features and the basic technologies used in intranets are the same as the ones used in the Internet such as Transmission Control Protocol and Internet Protocol (TCP/IP), the next chapter will be about the Internet. The later chapters will define intranet, intranet at ADA School, managing change, analysis of ADA School intranet and the prototype.

## II. INTERNET OVERVIEW

### A. HISTORY

It was early 1994 when people first heard about Intranet, thinking that it was a typo for the Internet. Although the two networks have some commonalties, they are nonetheless quite different.

What is the Internet and how did it begin?<sup>1</sup>

The Internet originated in the 1970s to provide the U.S. military with communications in case of nuclear attack. A few scientists used it to connect to each other. It was simply a network with an ability to send and receive messages among those scientists by packet switching data to make it attack- proof. Packet switching is the first and primary method used to move data around on the Internet. The main logic was breaking up the data into chunks, giving each chunk the address of where it came from and where it is going. Thus enabling many chunks of data from many different sources to co-mingle on the same lines, and be sorted and directed to different routes by special machines, called routers, along the way. This way many people can use the same lines at the same time and survivability can be ensured in case of an attack to any of the lines in the network. The name of this project was ARPANET.

The government organization behind this project was Advanced Research Projects Agency (ARPA)<sup>2</sup>, which was established in 1957 to keep pace with the USSR during space race. Supporting research in science and technology for military applications was its primary objective.

The first node in the network was established at UCLA and soon after, nodes were set up at Stanford Research Institute, UCBS, and the University of Utah.

In 1971, the number of connected nodes reached 15, as additional government and educational institutions came online and the capability to send email over the Internet was introduced. In a couple of years some, big universities were added to the network such as MIT, Harvard and Yale.

---

<sup>1</sup> A detailed timeline of the Internet history is given in Appendix A.

<sup>2</sup> The name of this agency has changed several times. The latest name is Defense Advanced Research Project Agency ( DARPA).



In 1974, a Harvard Ph.D. student introduced Ethernet, a protocol, which today is most widely used in local networks.

The Internet gained its maturity when TCP/IP architecture was developed at Stanford through the 1970's and adopted by DoD in 1980. Three years later, it was universally adopted and a new organization called The Internet Activities Board (IAB)<sup>3</sup>, was established to guide the evolution of this protocol suite. IAB has been acting like a consultant to the Internet community since then.

It has several task forces in it and perhaps the most effective one is the Internet Engineering Task Force (IETF) which holds three meetings a year to standardize new protocols and applications in the Internet. The IETF has about 75 working groups, each working on a different aspect of Internet engineering.

It also began to organize the documentation of the Internet. The first series of notes about the Internet was published in 1969 with a name, the Request for Comments (RFC). It is a way of sharing information among the network researchers. The latest number of RFC has exceeded 2500. RFCs can be accessed via any search engine in the Internet.

Despite the improvements through the mid 1980's, users of the Internet were still computer experts, engineers and scientists. The network was still too complex for ordinary users to involve and there were still no personal computers (PC) around. The Internet gained popularity among the ordinary users after the commercialization of the Internet.

After the TCP/IP was adopted universally and the DoD mandated the use of it, all of the vendors began to produce products upon those protocols. However none of those had enough information to build qualified products. In the light of this need, in 1985, IAB arranged a three-day workshop for all vendors to learn about TCP/IP. This was the first time for both sides to meet and know each other: the research group who had been working on the Internet architecture and TCP/IP and the enterprise. Over the next two years, a series of conferences, tutorials, design meetings and workshops continued.

The best result of these interactions was the consensus among the hundreds of vendors to ensure that everyone's product interoperated with all of the other products. In 1988, the first Interop trade show was performed among 50 companies. Today those

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<sup>3</sup> In 1992, the Internet Activities Board was reorganized and renamed as the Internet Architecture Board and became part of the Internet Society (ISOC) that is recently chartered.

shows are held in 7 locations around the world each year to an audience of 250,000 people who come to learn which products work with each other in a seamless manner, learn about the latest products, and discuss the latest technology. In parallel with the commercialization efforts that were highlighted by the Interop activities, the vendors began to attend the IETF meetings that were held 3 or 4 times a year to discuss new ideas for extensions of the TCP/IP protocol suite. ([www.isoc.org](http://www.isoc.org))

In 1989, the World Wide Web (WWW) was created by Berners-Lee at the European Laboratory for Particle Physics ( CERN ) and it boosted the growth of the Internet.

With the invention of WWW, a new organization called World Wide Web Consortium (W3C), was established and took the responsibility for evolving the various protocols and standards associated with the Web.

However government was still the only player behind the scenes. The NSFNet, which was funded by National Science Foundation, has served as a backbone of the Internet in United States for nearly ten years setting rules for its non-commercial government and research uses.

Since the Internet was initially funded by the government, it was originally limited to research, education, and government uses. Commercial uses were prohibited unless they directly served the goals of research and education. This policy continued until the early 1990's, when independent commercial networks began to grow. It then became possible to route traffic across the country from one commercial site to another without passing through the government funded NSFNet Internet backbone. Delphi was the first national commercial online service to offer Internet access to its subscribers in 1992. ([www.isoc.org](http://www.isoc.org))

In 1995 the National Science Foundation ended its sponsorship of the Internet backbone and all traffic relied on commercial networks. AOL, Prodigy, and CompuServe came online.

Finally, on October 24, 1995, the Federal Networking Council (FNC) unanimously passed a resolution defining the term Internet. The original text of this resolution is given in Appendix B.

In the early stages of the Internet there were so few internet users that most scientists knew each other's addresses. However the current number of users in the Internet is said to be in the millions as seen in Figure 1.

The Internet is now a network that, in January 1999, serves some 57 million connected computers. (<http://www.isc.org/ds/WWW-9907/report.html>)

The number of Internet users is a much more challenging number to estimate for January 1998 range from 40 million to 70 million users. Much of the discrepancy in these numbers reflects some uncertainty in defining a user of the Internet, particularly in the corporate environment. (Huston,1998, pg. 15 )

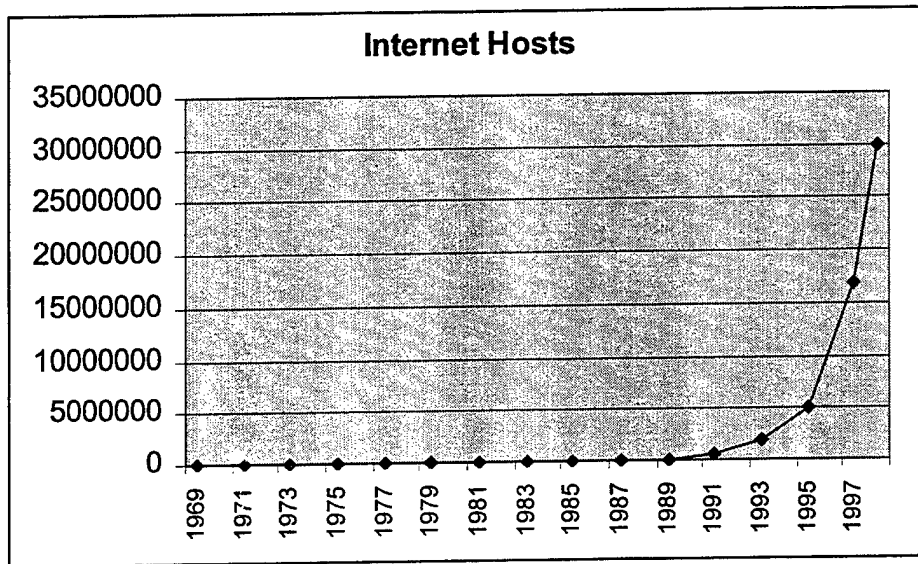


Figure 1. Internet Growth "From Houston, 1999, pg. 17"

## B. INTERNET ARCHITECTURE

### 1. TCP/IP and IP Address

The communication throughout the Internet is carried out via some protocols. TCP/IP suite is the main protocol group used in the Internet. TCP/IP is a suite, which consists of many protocols, such as User Datagram Protocol (UDP), Transmission Control Protocol (TCP) and Internet Protocol (IP).

IP is connectionless protocol. It accepts and delivers individual data packets that each specifies a destination. The communicating computers don't need to establish a connection before the communication. This is a potential vulnerability of IP. Packets may be lost or a third person can masquerade as a partner during the transmission, but IP has nothing to do to inform the partners.

TCP is connection-oriented protocol. It requires a pair of computers to establish a connection before sending data. To guarantee those connections are established and terminated reliably, after the communication, TCP uses a 3-way handshake method. Thus it ensures reliability which is fundamental for most Internet applications.

Every computer connected to the Internet has a unique address, called IP Address, which is issued by the Internet Assigned Number Authority (IANA). The length of an IP Address is 32 bits and conceptually consists of two main parts: a prefix that identifies the physical network to which the computer is attached and a suffix, which identifies an individual computer on that network.

Due to management issues, IP Addresses are categorized into five Classes; Class A, B, C, D and Class E. The first four bits determine the structure of the address.

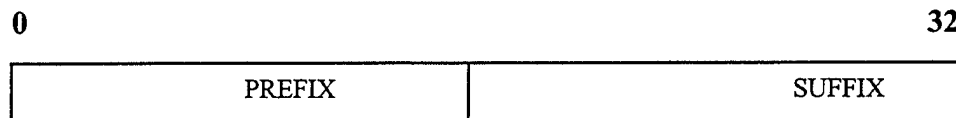


Figure 2. IP Address

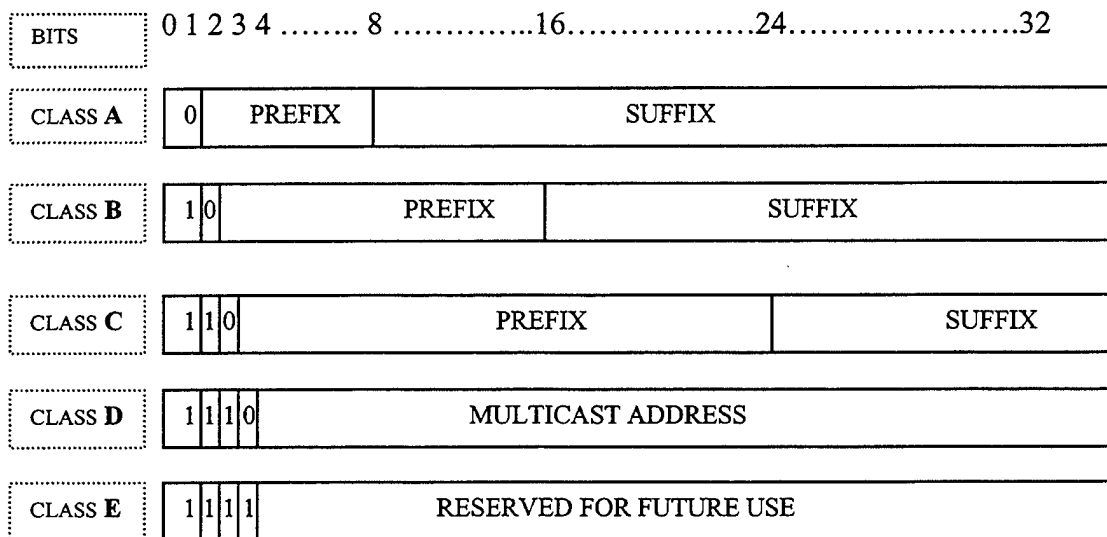


Figure 3. IP Address Classes. "From Comer, 1999, pg. 190"

The first three classes are called primary classes ( Class A, B, C) and are mainly used for assigning addresses to hosts. Class D is used for multicasting and Class E is reserved for future use.

Class A represents large national scale networks, which have small number of networks, and large number of hosts. Class B represents regional scale networks, and Class C represents local area networks with large number of networks and small number of hosts.

As seen in the figure 3 each class begins with some fixed values of their 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> bits. Thus there are limited numbers of networks in each class and there are limited numbers of hosts in each of those networks as seen in Table 1.

Class	Bits in prefix	Max. number of networks	Bits in suffix	Max. number of hosts per network
A	7	128	24	16777216
B	14	16384	16	65536
C	21	2097152	8	256

Table 1. Number of Hosts in Networks

It may be more efficient for computers to use 1s and 0s while dealing with addresses, however it is difficult for humans to figure out those numbers, therefore, an other schema has been improved: Dotted decimal notation.

32-bit space is divided into four parts and each 8-bit portion of binary digits are converted to decimal digits, and separated by periods.

Thus the binary form of IP Address,

$$\begin{array}{ccccccc}
 \underline{1000000} & \underline{10000000} & \underline{11111111} & \underline{00000000} & = & 128.128.255.0 \\
 \downarrow & \downarrow & \downarrow & \downarrow & & \\
 128 & . & 128 & . & 255 & . & 0
 \end{array}$$

Figure 4. Binary Conversion of IP Address

The range of addresses for each class is as follows:

Class A	1.0.0.0	-	126.0.0.0
Class B	128.0.0.0	-	191.255.0.0
Class C	192.0.0.0	-	223.255.0.0
Class D	224.0.0.0	-	239.255.255.255
Class E	240.0.0.0	-	255.255.255.254

## 2. IP Version 4.0 and New IP Version (IP V6)

Information is carried over the Internet in terms of packets, called IP Datagrams. A datagram has a header in front, used to navigate that data. In current version of IP (version 4.0) the header has a 32 bit IP Address location.

In the early age of the Internet nobody could imagine that one day, we would be short of IP Addresses as it seemed a pretty large range (Mathematically  $2^{32}$  addresses).

However, a few years ago, a problem occurred related to the IP addressing schema. The unexpected growth rate of the Internet accelerated the assignments of possible network prefixes. Class B addresses became the most popular addresses when most organizations took them as the most convenient and optimal solution for their networks with future expansion considerations.

Literally none of the organizations who reserved Class B addresses were able to fulfill all the host numbers ( 65536), rendering unused blocks of addresses around the whole world.

When some concerns about new Internet applications with special requirements such as audio and video delivery are added to those inefficient address assignments leaving unused portions of assigned blocks, computer scientists began working on IP version 6. It has a 128 bit address size and more enhanced features in it. It has an entirely new header format, which doesn't specify all the possible protocols. It has a schema, called extension header, which allows a sender to add additional information to a datagram. This schema makes IP version 6 more flexible than IP version 4.

In addition it has a new mechanism to support audio and video applications. It simply allows a sender and receiver to establish and use a high-quality path through the underlying network.

Recently some subnetting techniques were found to solve that address size problem causing to settle down the emergency.

Currently, IP version 4.0 is still being used and it is so popular that it seems difficult to have a smooth transition to the new IP protocol.

### 3. Domain Name System ( DNS)

It would be too difficult for humans to use binary digits or even decimal digits for IP Addresses. Instead, we find it more convenient to use meaningful strings as addresses. It is much easier to write down “ www.nps.navy.mil” to go to Naval Postgraduate School web site, rather than typing 125.131.254.52.

This new schema is called the domain name system (DNS) and the translation of meaningful strings into numbers, which are more convenient to computers, is called name resolution. It is simply a distributed database over the Internet. It has several computers, known as DNS servers, running at different locations.

Each computer has a large database of string addresses corresponding to IP Addresses in decimal numbers. The computers have a tree hierarchy among them. Whenever a computer can't find any correspondence to an entered string, it can ask an upper level computer for help, till it gets the answer. However, for network traffic considerations, if it can not find the address in a certain time it sends a message to the user that it couldn't find the address, despite the fact that that address may exist.

There are no restrictions about the number of segments in a domain name. The most important segment is on the right, while the least important segment is on the left.

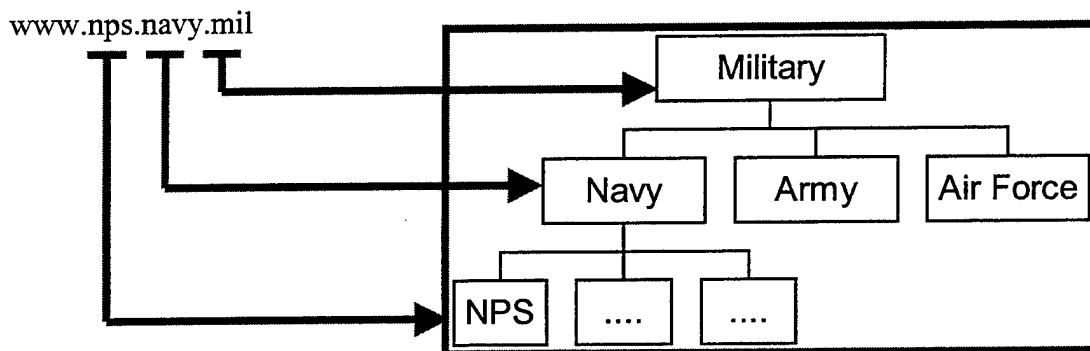


Figure 5. Domain Name System

The following is a list of the top-level domain names that are commonly used:

. com	Commercial organization
. edu	Educational institution
. gov	Government organization
. mil	Military group
. net	Internet Server Providers (ISP)
. org	Non-profit organizations
. arpa	Temporary ARPA domain (still used)
. int	International organization
. country code	A country ( uk = United Kingdom, tr = Turkey..)

#### **4. Routers**

The basic hardware component used to connect heterogeneous networks is a router, a special purpose computer behaving like a bridge. Many of those routers, mostly managed by Internet Service Providers( ISP ), connect different networks throughout the whole world. See appendix C for a detailed working mechanism of the routers.



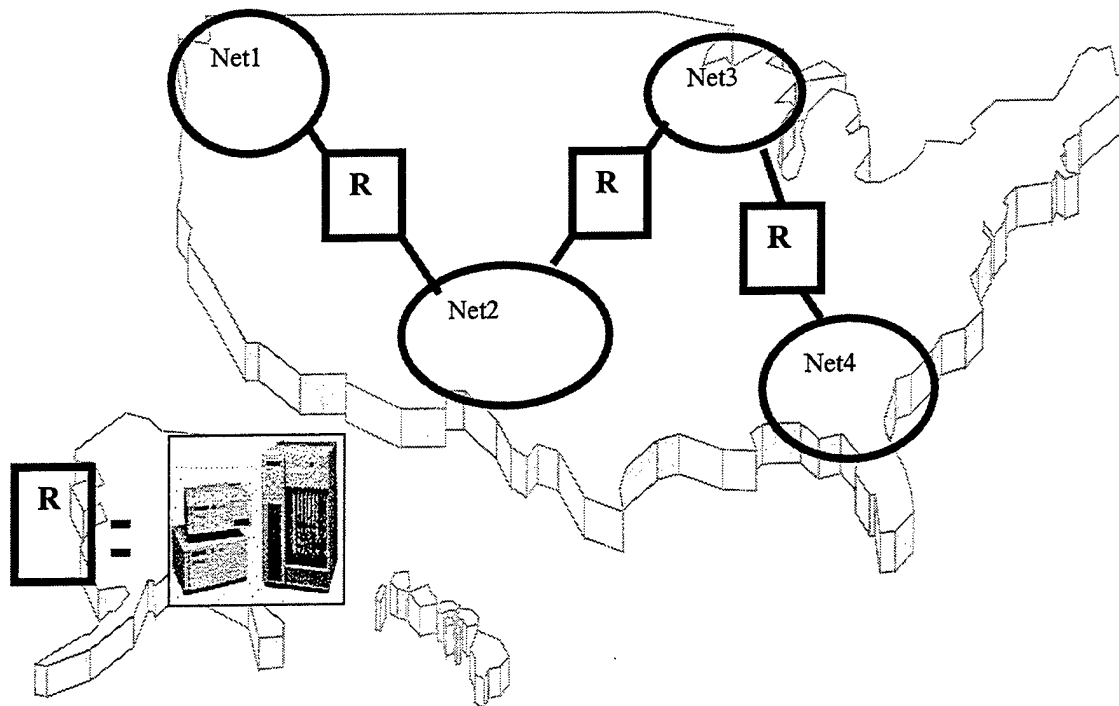


Figure 6. Routers

### C. CHAPTER SUMMARY

The initial steps for creation of the Internet were taken exactly 30 years ago. It began as a military research project and had an enormously dynamic evolution process. Half a decade ago, this process included commercialization by the US government's taking his hands from it.

Today, the Internet is composed of more than 60,000 constituent networks. Each network is operated autonomously, and the only common factors shared by all these networks are the use of a common protocol, the adherence to a common address management structure, and the adherence to a common name structure. No center can be found to this mesh of connectivity. No single landmark proudly proclaims "This is the Internet. Connect here." Instead, every point on the Internet can be extended and can offer further connectivity. This network has no center- only an expanding circumference. (Huston, 1998,pg. 91)

### **III. INTRANET**

#### **A. HISTORY**

Intranet is a private network that uses the same Internet technology such as TCP/IP protocol suite and browsers. It all began in the early 1990s, when companies such as Lockheed, Hughes and SAS Institute, decided to try a pilot program to see if there was any value in using the common Internet tools, such as gopher, File Transfer Protocol (FTP), and the Web, in a commercial environment. Sure enough they found the tools to be useful. Word of their experiences started leaking out just as companies were starting to take an interest in the Internet itself. (Hills, 1998, pg. 6) Companies began with email systems to connect to the outside, and then web servers, with browser technologies, followed them.

A Browser is a computer program used to access and display information from the World Wide Web (WWW). Graphical User Interfaces (GUI) made browsers extremely user friendly, thus enabling everybody to use the Internet and its resources without requiring any deep computer science background.

People soon realized that they could use the same browsers to access their internal information and to establish communication and collaboration among the company workers. Having already invested in the Internet, they did not have too much additional expenses.

Basically they were using the same underlying architecture and network protocols as the Internet. Protocols such as the Transmission Control Protocol (TCP), the Internet Protocol (IP), the Simple Mail Transfer Protocol (SMTP), and many others are what make it all possible.

The idea of creating your own Internet has spread widely introducing the private networks or the Intranet.

#### **B. INTRANET ARCHITECTURE**

TCP/IP suite is the basic protocol suite used in the Intranet. An Intranet doesn't have to have an Internet access, despite the fact that the Internet offers great resources and has a positive motivation over the employees.

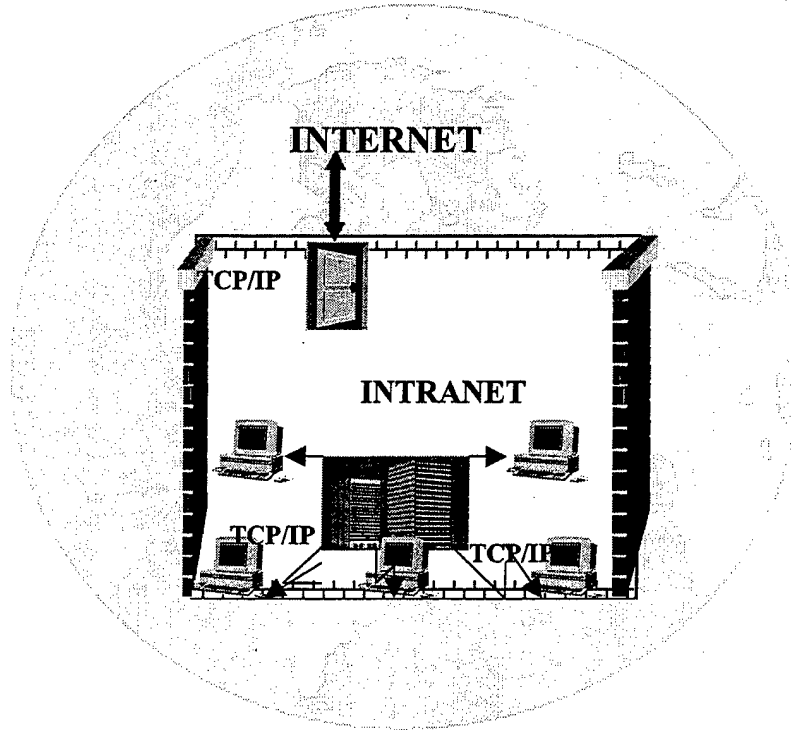


Figure 7. Intranet Structure

In case of a high security concern, it is possible to have an Intranet with no connection to the Internet. However, due to the benefits of the Internet, most organizations prefer to have that connection and tighten their security by using some special software and hardware. The software and hardware combination that is used to provide such security is called a firewall. When you visit a web page of an organization on World Wide Web, most probably, you are visiting a part of that organization's intranets. Most Intranets have a navigation layer which starts from the home page and offer common features such as contents, search, and help at the top. Further on, under the home page, they have more detailed information. Figure 8 is an illustration of a typical intranet.

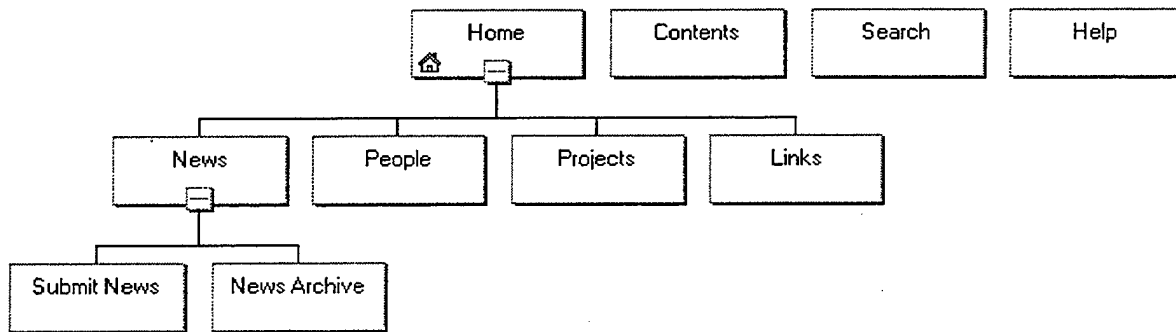


Figure 8. A Typical Intranet

Whatever networking structure the organizations have, TCP/IP protocols and some common tools such as Common Gateway Interface (CGI) scripting enables users to communicate on the same platform. Thus they can exchange or manipulate information regardless of the physical structure. They can work on the same project, send email to each other or reach legacy database systems and retrieve and modify data.

Browser programs such as Microsoft Internet Explorer or Netscape Communicator are used to carry out those operations.

The physical components of Intranet will be explained in the next chapter in more detail.

## C. COMPARISONS

### 1. Intranet vs Internet

They both use the same TCP/IP protocol suite as the underlying architecture. The original intention of the Internet was scientific and nobody had envisioned the current growth of it. Due to the inherent vulnerabilities in the protocols that are used, the Internet doesn't have a very secure environment. At least there are no clear boundaries around it, and it makes it extremely difficult to control all the users. Having experienced those security vulnerabilities, organizations have found different means to ensure security in

Intranets. They either completely disconnect their Intranets from the Internet or, have some restricted access to the Internet as explained in the earlier section.

Intranets are mostly used within the organizations. Therefore the number of users and the quality of the physical structure such as the bandwidth and the performance of the hardware being used are under the control of those organizations. Thus, most of the time, the speed of data transfer in Intranets is higher than that of the Internet.

The more control you have, the more security and reliability you get. It is obvious that Intranets are more secure and reliable than the Internet. The following table is a simple comparison between Intranet and the Internet.

	INTERNET	INTRANET
Security Issues	High risk	Low risk ( If there is no connection to the internet then the only threat is insiders)
Speed	Generally low due to the uncontrollable bottlenecks,	High, because, the organization has the incentive and control to adjust speed.
Services	A variety of services are available	Depends on the organization's will
Access Control	Open to the public	Limited public access
Reliability	High risk	Low risk

Table 2. The Internet and Intranet Comparison

## 2. Intranet vs Extranet

Extranet is a combination of corporate intranets and the Internet. Today most big organizations are either nation wide or worldwide. A corporation may have many offices, each with its own intranet, spread throughout the whole country.

Each intranet is connected to each other via the Internet. Some additional features such as leased lines, digital certificates, encryption of messages or the use of virtual private networks (VPNs) that tunnel through the public network are used to ensure security.

An extranet can also be called as a private network that uses the Internet protocols and the public telecommunication system to securely share part of a business's information or operations with suppliers, vendors, partners, customers, or other businesses. The following is a list of what can be done in an extranet:

- a. Exchange large volumes of data using Electronic Data Interchange (EDI)
- b. Share product catalogs exclusively with wholesalers or those "in the trade"
- c. Collaborate with other companies on joint development efforts
- d. Jointly develop and use training programs with other companies
- e. Provide or access services provided by one company to a group of other companies, such as an on-line banking application managed by one company on behalf of affiliated banks
- f. Share news of common interest exclusively with partner companies (<http://whatis.com/extranet.htm>)

#### **D. GROWTH OF INTRANET**

There is a consistent growth curve of intranet, and Hills figured out a way to express this growth without using any numbers other than time; she plotted only the x-axis and time, you can apply whatever variable you want for the y-axis.

This can be whether the number of Internet hosts, domains, servers, or users, or the number of Intranet servers or users. "Campbell, estimates that there were 100,000 intranet web servers in 1995, and that this number will grow to 4.7 million by the year 2000. He also said that there were approximately 10 million Web browsers in use in 1995, and he estimates that number will be 180 million in the year 2000." ( Hills, 1997, pg. 8 )

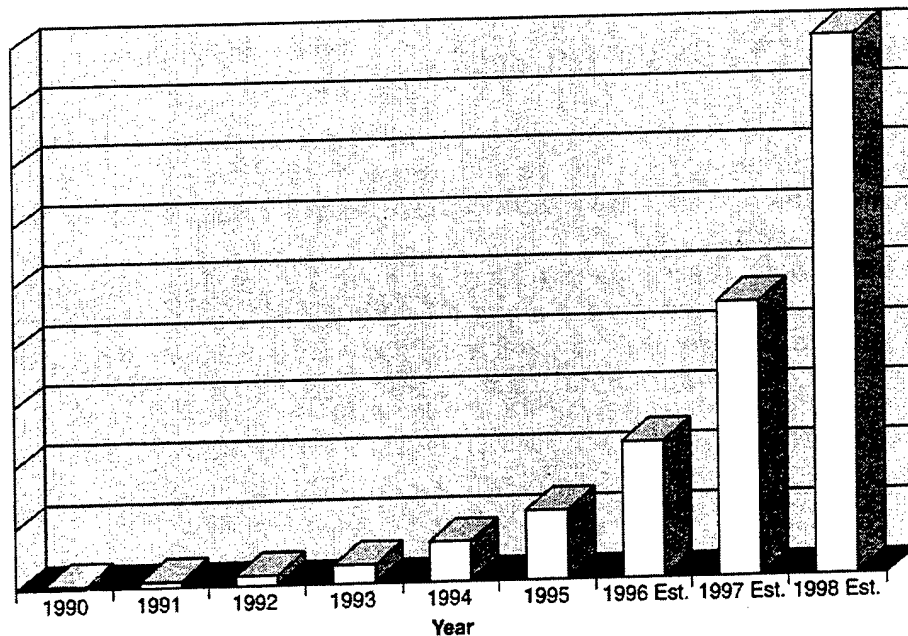


Figure 9. Growth of the Internet "From Hills, 1997,pg 7"

If we compare the growth rate of the Intranet to the growth rate of the Internet, I can assure you that Intranet grows much faster than Internet does, mostly due to the extreme easiness and quickness of deployment.

According to Coleman, 1997, International Data Corporation reported that even in 1995 sales of Web servers for Intranet use exceeded those for Internet use by 10 percent, and it forecasts that by the year 2000 server licenses for Intranet usage will outdistance those for Internet usage by 10 to 1. Netscape Communications Corporation says that about 80 percent of its revenue comes from companies that primarily use its technology to set up Intranets. Microsoft Corporation, Netscape's rival in the browser war, reports that 80 percent of its Internet servers are used on Intranets.

#### **E. BENEFITS OF INTRANET**

It has been nearly five years since the arrival of the Intranet applications. What caused the business to demand for Intranet, leading an explosion, since then?

Basically most companies are in need of an open-architecture, and a cost-effective solution for distributing information through their organizations, where employees want better information faster.

Hills (1997) organized those benefits and defined two different types; the Tangible Benefits and the Intangible Benefits.

### **1. Tangible Benefits of Intranets**

Tangible benefits are those you can express in terms of measurable or quantifiable parameters like money or time.

Here are some examples for tangible benefits:

- Fast and easy to implement
- Cheap to implement
- Easy to use
- Saves time
- Provides operational efficiency
- Saves cost
- Based on open standards
- Connect and communicate among disparate platforms
- Put users in control of their data
- Secure
- Scalable
- Flexible
- Provide the richness of multimedia
- Leverage your infrastructure and applications investment
- Supports push technology
- Collects data as well as distributing it

### **2. Intangible Benefits of Intranets**

Intangible benefits are those that you cannot express in terms of measurable or quantifiable parameters. It is much harder to put a value on intangible benefits. However, the intangible benefits may be much more valuable than the tangible ones. That is because it is hard to put monetary value on making the organization more competitive. If you have more knowledgeable and self-reliant employees, who are more productive,



make better decisions, and do a better job of serving customers, how can you possibly put a value on that? ( Hills, 1997, pg. 39)

Here are some examples for intangible benefits:

- Provide better communication
- Provide access to accurate information
- Capture and share knowledge and expertise
- Provide better coordination and collaboration
- Provide for creativity and innovation
- Provide new business opportunities
- Provide new business partnerships through access by suppliers and customers

## **F. DISADVANTAGES AND RISKS OF INTRANET**

Despite its widely acceptable benefits, setting up an Intranet in an organization may cause some disadvantages or risks.

Hills (1997) grouped those concerns into 7 titles:

- ◆ Potential for chaos
- ◆ Security risks
- ◆ Management fears
- ◆ Information overload
- ◆ Waste of productivity
- ◆ Not an integrated solution
- ◆ Hidden or unknown complexity and cost

### **1. Potential for Chaos**

The ease of implementation of an Intranet enables most of the employees to have their own web pages.

This may be beneficial to the organization in terms of communication between the users, however in case of a poor initial design, things may go out of control causing a chaos.

### **2. Security Risks**

The Intranet Technology can be implemented by either isolating the organization from the outer world, or connecting to the Internet. In case of an isolation there is not too

much security concern other than insiders. However if you have connectivity to the Internet you should ensure that enough security measurements are taken prior to the implementation. Even if you use a firewall, it doesn't ensure security, because you may not configure it properly and the lack of user awareness can cause break-ins.

In 1984, the American Bar Association Report of Computer Crime suggested that about 78 percent of all offenders in computer crimes were insiders who usually had authorized access to the systems they damaged or abused. (Kabay, 1996, pg.11-12)

So by implementing the Intranet in organization from the scratch can open most of your sources to those kinds of insiders.

### **3. Management Fears**

While the more you know the more powerful you are, the more you share the more powerful your organization is.

The fear of sharing information is one of the most difficult disadvantages to deal with. Intranets scare those middle managers who have always hoarded information and refused to share it with their subordinates. These managers are afraid that their jobs are in jeopardy if everyone has information. That may be true. Intranets empower users and you don't have to manage them. (Hills, 1997,p.47)

### **4. Information Overload**

Without a carefully designed structure and implementation plan, the amount of information may get out of control very soon. People will try to load every information on the Intranet that they use without seeking priorities. This may cause an overload.

We began to use computer technology, initially to get and store data, and then to convert those raw data into meaningful items, information. The next phase is converting that information into knowledge. A good solution for this problem may be using Artificial Intelligence Technology and installing software agents on our Intranet.

### **5. Negative Productivity**

When people meet the Intranet, naturally they will spend some time on it. Some will use this time efficiently, some not. They may play games or deal with unnecessary communication within the organization. Especially if you have Internet connectivity, the

second group will exceed the first one. You cannot avoid your employees surfing the web (World Wide Web).

This is a trade off, you will certainly have a transition period. However by using well prepared policies, guidelines and credible training sessions you may shorten this period and motivate the users on their own work.

#### **6. Not an Integrated Solution**

This issue used to be a problem, but today most vendors provide such products that they almost are integrated. You no longer need to buy several software products from different places and try to integrate them.

#### **7. Hidden or Unknown Complexity and Cost**

Although Intranets are relatively inexpensive in comparison to client/server, they can still cost serious money for sophisticated applications linking internal Web servers with existing corporate applications. (Hill, 1997, pg. 49)

## **IV. INTRANET COMPONENTS**

The number of Intranet components varies from organizations to organizations, as there is no exact consensus on its definition and the applications evolve very dynamically.

However, today most Intranets have these components (Hills, 1997, pg. 9).

- ◆ Network
- ◆ E- mail
- ◆ Internal Web
- ◆ Mail lists and Listeners
- ◆ Newsgroups
- ◆ Chat
- ◆ Video Teleconferencing
- ◆ FTP
- ◆ Gopher and WWW
- ◆ Telnet
- ◆ Instant Messaging

### **A. NETWORK**

In a broad sense a computer network is a collection of computers connected to each other so that they can exchange data among each other.

As the major component of the Intranet, networks provide the main infrastructure for communication.

Many organizations have a substantial number of computers in operation, often located far apart. For example, a company with many factories may have a computer at each location to keep track of inventories, monitor productivity and do the local payroll. Initially, each of these computers may have worked in isolation from the others, but at some point, management may have decided to connect them to be able to extract and correlate information about the entire company. The issue here is resource sharing, and the goal is to make all programs, equipment, and especially data available to anyone on the network without regard to the physical location of the resource and the user.

Providing high reliability and saving money are additional goals. (Tanenbaum, 1996, pg. 3)

### 1. Network Categories

Networks can be classified by their physical shape, or topology. Networks can also be classified by their geographic scope and type of services provided.

The most common networks classified by the geographic scope are Local Area Networks ( LAN ) and Wide Area Networks ( WAN ).

A Campus Area Network (CAN) covers a larger geographical area than a LAN, on the order of a few miles. A Metropolitan Area Network (MAN) would cover an area the size of a small city. A Wide Area Network (WAN) provides connection between sites in diverse locations (IPT and DoN INPO, 1997).

A ship can have its own LAN, and several networks in more than one ship can form a Metropolitan Area Network. Several MANs can form a Wide Area Network. Finally, the Internet is formed by those WANs.

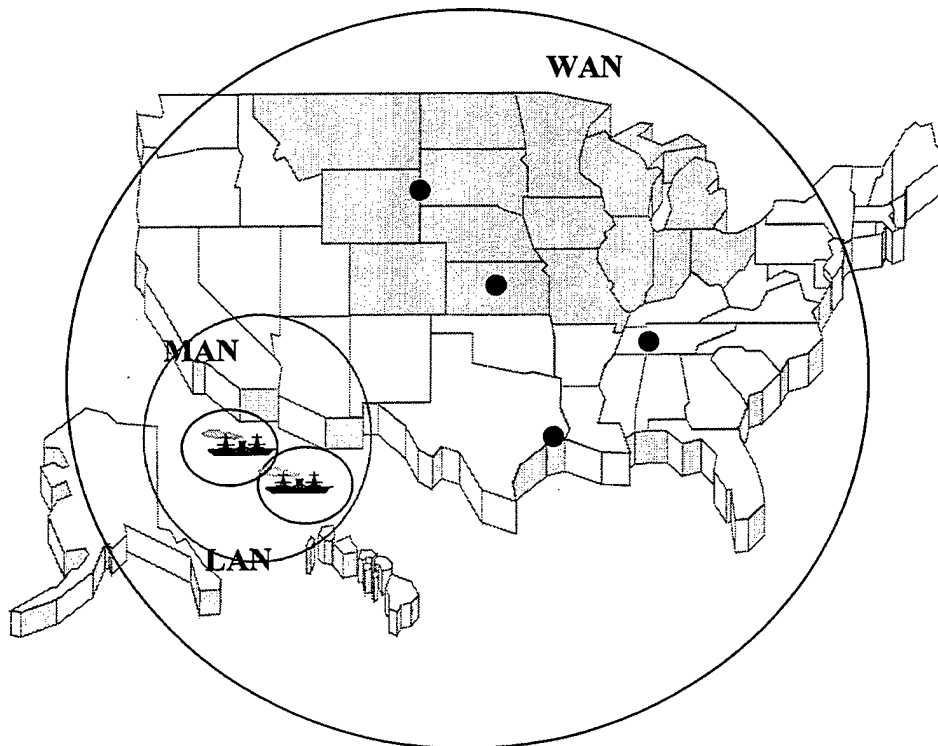


Figure 10. Network Categories

*a. Local Area Networks*

A Local Area Network encompasses a limited distance, usually one building or several buildings in close proximity. Most LANs connect devices located within a 2000 foot radius and have been widely used to link microcomputers( Laudon, 1997, pg. 246).

LANs emerged in the early 1970s, as a substitute for large mainframe computer systems. It had become apparent that, for many enterprises it is more economical to have a number of small computers, each with its own self-contained applications, rather than a single large system. Because each small computer is likely to need a full complement of peripheral devices such as disks and printers and because some form of data sharing is likely to occur in a single enterprise, it was a natural step to connect these small systems into a network ( Galvin, 1998, pg. 482 ).

LAN technologies have become the most popular form of computer networks. They now connect more computers than any other type of network. One of the reasons so many LANs have been installed is economic: LAN technologies are both inexpensive and widely available ( Comer, 1997, pg. 56).

Comer (1999) also refers to one of the fundamental principles of computer networks, locality of reference as a major reason for the popularity of LANs. This principle states that communication among a set of computers is not random, but instead follows two patterns. First, if a pair of computers communicates once, the pair is likely to communicate again in the near future and then periodically. Second, a computer tends to communicate most often with other computers that are nearby.

One of the major components of LANs is the File Server, which is a more powerful computer than the other computers in a network. It has the network operating system and various programs on it and basically manages the entire network.

All the components are connected to each other by special communication devices usually called hubs.

The following figure illustrates a simple LAN with star topology.

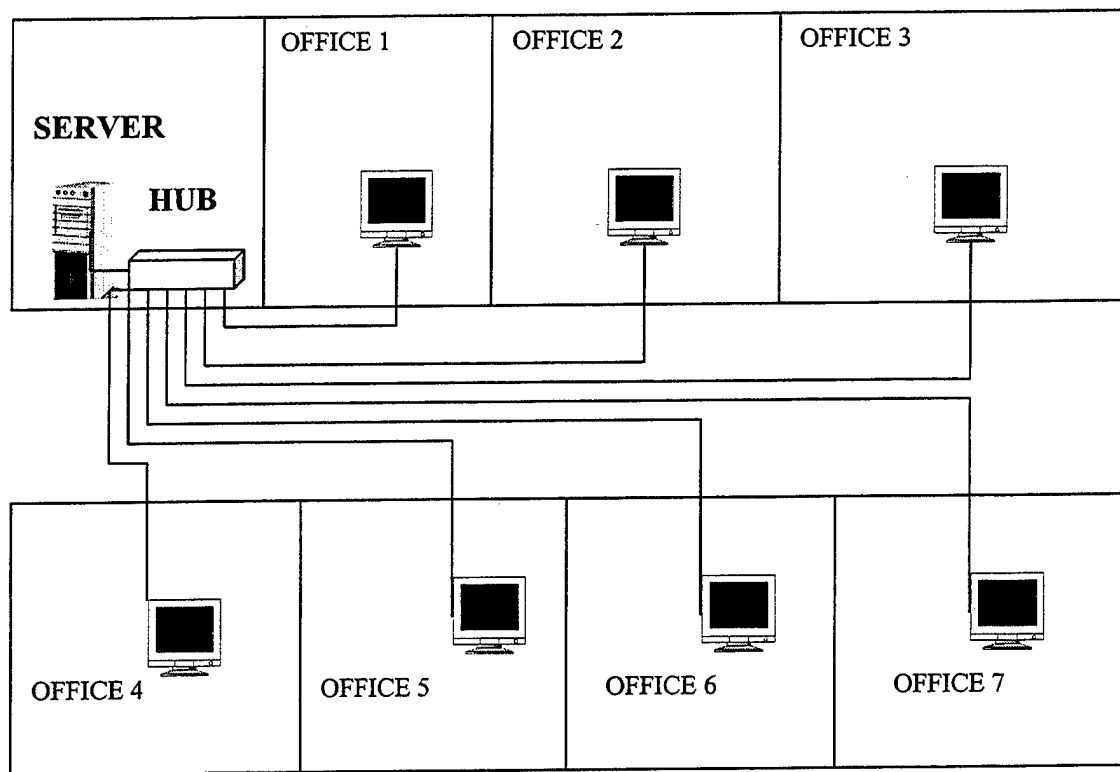


Figure 11. LAN With Star Topology

The advantages of a LAN are (Levy and Hartwig, 1998, pg.6):

- a. It enables anyone on the network to share and use expensive hardware and software.
- b. It reduces the chance of losing your data by broadcasting copies of important documents to several locations supporting centralized backup.
- c. It reduces the chance of computer viruses and unauthorized data copying by having employees access shared data through "diskless workstations" that is, computer-like network terminals that have all the capabilities of a regular PC and/or network workstations, except the capability to copy files onto a floppy disk.
- d. It establishes data and mail links between otherwise incompatible computer systems.

- e. It arranges instant memo-and data sharing between coworkers on group projects.
- f. It softens the blow of individual computer crashes by letting you finish the crashed job immediately at some other workstation.

The pitfalls of a LAN are:

- a. Someone will have to configure the LAN to ensure that a user's private data is not accidentally accessed by another user, or published.
- b. Running wires between all the computers on a network can be expensive and time-consuming all by itself.
- c. LANs can result in more dependency on outside consultants to plan and troubleshoot the system.

There are mainly three network topologies: star topology, ring topology and bus topology. Either the physical shape or logical operation of a network determines its topology. Because they are mostly used with LANs, those topologies are also called LAN topologies, therefore the author will refer to them under the LAN heading.

(1). Star Topology. All the computers are connected to a central communication device that is called a hub. This electronic device accepts data from a sending computer and delivers it to the appropriate destination. It simply manages message traffic in the network. Figure 12 shows an ideal star topology, however practically it is very rare that you have a network in which all the components are symmetrically distributed. Generally user computers are spread through the buildings and hub and server are located in special reserved rooms.



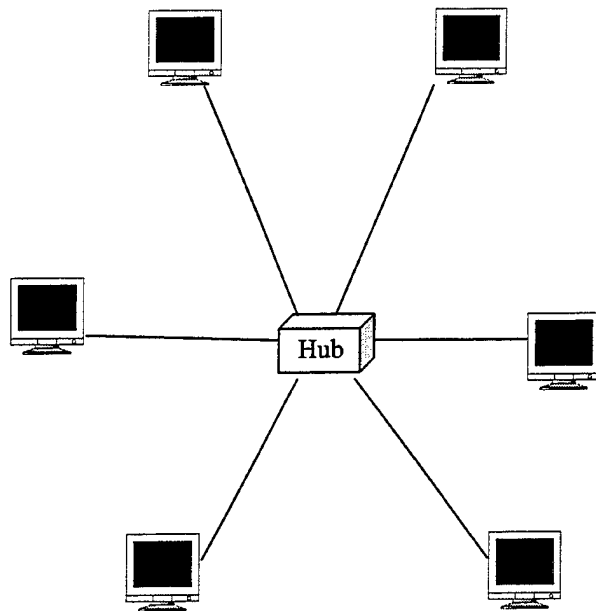


Figure 12. Star Topology

The main difference between a star topology and the other topologies is that, the data is not propagated throughout the whole network. The sender sends the data to the central electronic device and then it is directed to the receiver. Thus unnecessary data traffic is omitted. Besides the data travels between only the corresponding sites, which makes it easy to ensure data security within the network. A third party can not eavesdrop.

Continuity of service is better than the other topologies. In case of disconnection between a computer and the central electronic device, the only affected party is that particular computer. The other computers can continue their communication, unless there is something wrong with the central electronic device. However, the amount of cable that is used to establish the network is usually greater than the amount needed in other topologies and this increases the overall cost.

ATM (Asynchronous Transfer Mode) networking technology is a good example for this topology, though it is also used in WANs. Simply, there is an electronic switch to which, many computers can connect. It is usually designed to provide

high bandwidth such as 100 Mbps or faster. ATM networks usually use fiber optics in cabling, in order to achieve this high rate data transfer.

(2). Ring Topology. All the computers are connected to each other in a closed loop. The network is very vulnerable to cable failures. In case of a connection problem between any two computers, the entire network will fail. For that reason, some additional features are included to provide reliability.

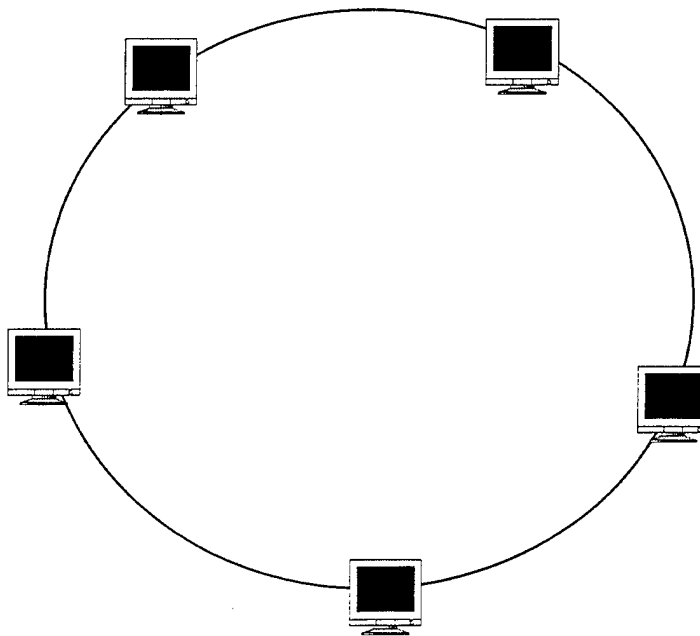


Figure 13. Ring Topology

IBM Token Ring and FDDI ( Fiber Distributed Data Interconnect ) Ring Networks are the most common ones that use this topology.

IBM Token Ring uses special messages or called tokens to coordinate communication by giving permissions to computers once at a time. So when a computer needs to communicate to an other computer, it waits for the token to get permission to access the network. After the message is sent, the destination makes a copy of the received data while all the other computers just pass it. The final destination of the data is again the sender computer. Thus integrity of data is ensured.

FDDI overcomes the main disadvantage of a ring topology. Instead of copper wires, a pair of optical fibers, which is faster and more reliable, are used.

A ring topology makes it easy for computers to coordinate access and to detect whether the network is operating correctly. When additional pairs of cables or fiber optics as in FDDI, are used the redundancy increases the reliability of the system. Even if a cable is cut, the redundant cabling enables the network to operate as seen in Figure14.

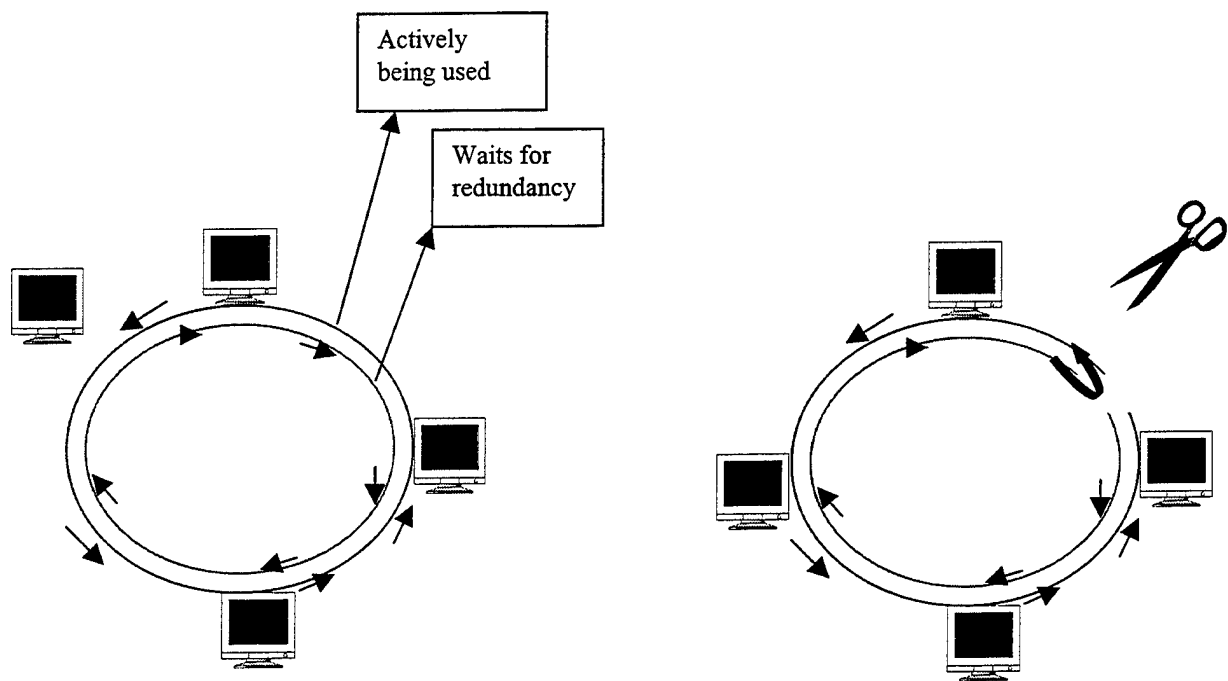


Figure 14. Ring Topology

There are two rings, the outer ring, that is being used actively and the inner ring that waits to be used in case of a cable failure. The direction of data transfer is opposite in both of them. This schema enables the inner ring to connect to the outer ring and keep the network on, if there is a physical disconnection on the network.

Having this high reliability feature, FDDI networks are mostly used in military applications, where the continuity of the networks are vital and there is a great requirement for reliability such as sophisticated weapon systems.

However, due to the cost issues, this topology is not as common as bus topology, in commercial business.

(3). Bus Topology. The computers in the network are attached to a cable, which connects all of them together. They communicate with each other by sending electrical signals down in the cable. Each of the computers has the ability to sense those signals.

A bus requires fewer wires than a star, but has the same disadvantages as a ring, and that is the network is disabled if someone accidentally cuts the cable ( Comer, 1997, pg. 39).

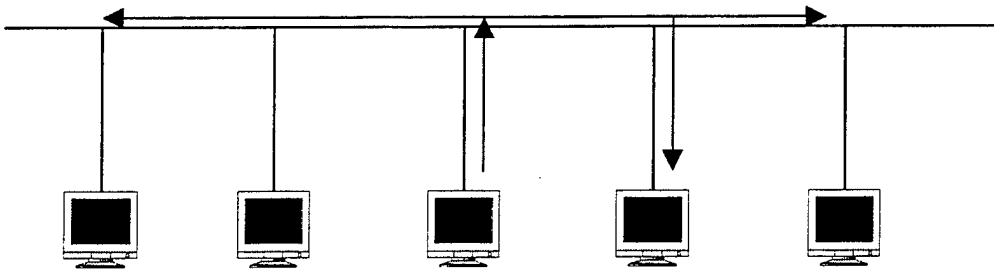


Figure 15. Bus Topology

The most widely used network technology, Ethernet has a logical bus topology. It was invented in the early 1970s and it is so common that its standards are controlled by IEEE (Institute for Electrical and Electronic Engineers).

The sender computer sends the message to both sides of the ethernet cable. The message travels across the cable and the destination computer captures the message from the cable. All the computers can always listen to the cable, however they can send a message one at a time. Therefore they have to wait each other till the shared cable becomes available for use.

This schema has been the most popular of all the networking topologies. The wide market share has decreased its cost a lot. The hardware and software to implement this topology has the least cost among the other topologies. That is why it is so common in everywhere.

The most common Ethernet networks are: 10Base T with a 10 Mbps bandwidth, 100Base T or Fast Ethernet with a 100 Mbps bandwidth and lately

Gigabit Ethernet with 1000 Mbp bandwidth.

*b. Wide Area Networks*

A WAN is a network that consists of several LANs or computers connected to each other, spanning an arbitrarily long distance.

The key issue that separates WAN technologies from LAN technologies is scalability. A WAN must be able to grow as needed to connect many sites spread across large geographic distances, with many computers in a large corporation that has offices or factories at dozens of locations spread across thousands of square miles. Furthermore, a technology is not classified as a WAN unless it can deliver reasonable performance for large size networks. That is, a WAN doesn't merely connect to many computers at many sites, it must provide sufficient capacity to permit the computers to communicate simultaneously. (Comer, 1998, pg. 120)

WAN technologies use special devices, called switch for connections. Usually, a switch is connected to another switch at a high speed. However individual computers can also be connected to a switch with relatively low speed.

The most common examples for WAN technologies are:

- ARPANET
- X.25
- ISDN (Integrated Services Digital Network)
- Frame Relay
- SMDS (Switched Multi-megabit Data Service)
- ATM

## 2. Network Components

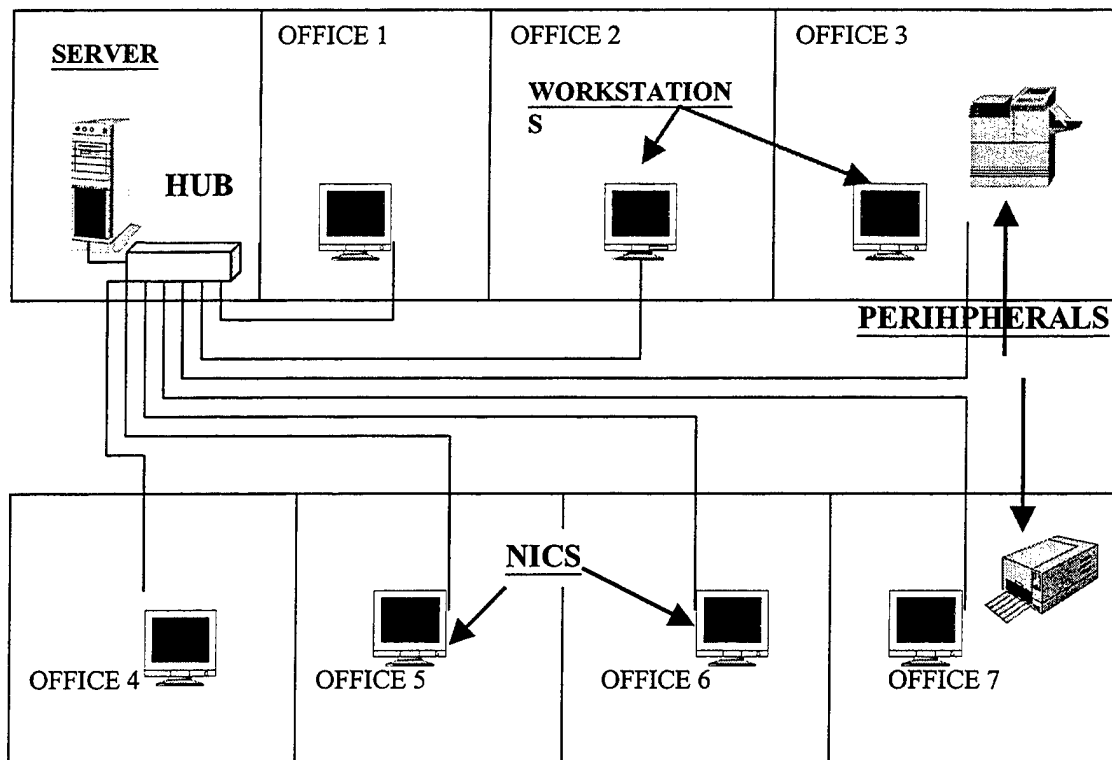


Figure 16. Network Components

### *a. Server*

A server is an application, which provides service to the clients who make requests. Having the network operating system installed on it, a server computer can be used to manage the network.

In a typical network, a server computer has more disk storage and more powerful processors than the other computers in the network. Thus it can provide better and faster service. There are different kinds of servers, where file, application and printer servers are the most common ones.

Some of the other servers can be listed as web servers, ftp (file transfer protocol) servers, mail servers and database servers.

A web server contains web pages and uses a protocol called hypertext transfer protocol http, to handle user requests. Those are the computers that provide us with web pages when we surf the Internet.

An ftp server contains data to be shared and uses file transfer protocol to send and receive data from the users.

A database server contains database and enables the users to interact with the database.

A mail server is an application, which basically manages message transfer between the users.

Once again, a server is not a computer, it is an application and one computer can host more than one server. For example, you can have a web server such as Internet Information Server 4.0, an ftp server, a database server such as SQL 7.0, a mail server such as Microsoft Exchange and NT Server on the same computer and still manage you network with that same computer.

#### ***b. Workstations***

Workstations are the computers that behave as clients on a network. A workstation may have programs on it and enable the user to control the computer environment or it may not have any application programs on it and simply use all the resources that belong to a server.

User's data may either reside on the workstation or on the server. It depends on the organization policy. For instance if the organization wants to make regular backups with a centralized control, workstations do not have to hold the user's data.

#### ***c. Hub***

A Hub is an electronic device used to handle data traffic among the computers within a network. The data may be distributed, amplified, regenerated, screened or cut off. The hubs with no additional features to handle message traffic are usually called dummy hubs.

If the hub can be configured remotely, it is called smart hub and if it can sense the message traffic and manage to send a message to its destination using the most effective path, it is called a switched hub.

Hubs have also different names depending on the type of LAN. In token ring LANs they are referred to as Multistation Access Units or Controlled Access Units (MAUs or CAUs). In 10BASE-T Ethernet, they are referred to as concentrators. In ARCnet they are simply called hubs. Hubs vary in their capabilities and sophistication. ARCnet passive hubs are inexpensive and only split signals among several devices. Other hub units cost several thousands of dollars providing state-of-the-art remote management and diagnostic capabilities. (Coulter, 1997)

*d. Network Interface Cards (NICs)*

NICs are the hardware components that enable the computers to participate to a network.

Computers handle tasks with their Central Processor Units (CPU). CPU is the heart of a computer. The main schema that most of the computers use to handle tasks is to put the tasks in a queue process them with some sort of algorithms. So, some of the tasks need to wait while others are being processed.

Computers have to dedicate their CPUs, in order to handle network issues like data sending and receiving, status reporting and listening to a network. Instead of using computers' valuable CPU processor time for those kinds of networking tasks, NICs are invented to carry out those tasks. Without NICs the response time in a network would be painful as some of the required tasks may wait in the queue of the CPU, and sometimes would be discarded.

Each kind of network topology requires its own kind of NIC. So, if you are planning to set up a Fast Ethernet you need a NIC that is specifically produced for that kind of networking. Though there is a middle product called 10/100 BaseT Ethernet NIC that can be used in both 10BaseT and 100BaseT Ethernet networking. However you can not use them in a FDDI topology.

By the way some of the computers such as Macintosh, do not need NICs for network connection. They have built-in capability for networking.

*e. Peripherals*

Peripherals are any kind of resources attached to a computer in a network. It may be a scanner, a printer, a CD-ROM or a web camera. The main idea is to share those resources among the users in a network.



*f. Software*

Network Operating System is the main software program that manages the network.

A network operating system provides an environment where users, who are aware of the multiplicity of machines, can access remote resources by either logging into the appropriate remote machine, or transferring data from the remote machine to their own machines. ( Galvin, 1998, pg. 501)

It is simply like a socialist government that manages economy. It decides which users will use which resources in what ways.

Resource sharing, computation speed up, reliability, and communication are the four major reasons for building a network. The primary goal of a network operating system is to provide those main four services.

The common network operating systems in business are Microsoft's Windows NT, Novell's NetWare products and Unix.

Microsoft claims that NT has the greatest market share in the business. According to a Microsoft press release, over one million Internet sites use the Microsoft Windows NT Server operating system as of March 16, 1999. In the same release they claim that that unprecedented momentum is further evidenced by the results of a recent IntelliQuest Inc. report, which found that Windows NT is the most frequent deployed corporate Internet platform. (<http://www.microsoft.com/PressPass/press/1999/Mar99/IISmilPR.htm>)

On the other hand, International Data Corporation (IDC), finds that Windows NT's major use in many enterprises is as a departmental infrastructure software server (file/print, messaging, and communications) rather than as a major enterprise server running mission-critical applications. Furthermore, where applications are being run on Windows NT, they appear to be packaged commercial applications rather than custom-built applications. However, NT-compatible software is finding its way into organizations of all sizes and in all vertical markets. (<http://www.novell.com/text/advantage/idcreport.html>)

Novell NetWare is most often used for file/print services, directory services, and communications services, and it can be considered part of the computing infrastructure fabric in most major corporations. Organizations using the NetWare

operating environment often cite its strengths and reliability as the primary reasons they have not adopted Windows NT Server.

IDC's studies have shown that Unix is most often used for transaction processing, database support, and support for custom commercial and technical applications. Major enterprise-scale packaged commercial applications are often hosted on Unix, even in cases in which they are not available on NT.

## **B. E-MAIL**

Originally, electronic mail was designed as a straightforward extension of the traditional office memo. First email systems were built to allow a person to communicate with other people; an individual created a message and specified other individuals as recipients. The e-mail software transmitted a copy of the message to each recipient. (Comer, 1999, pg. 381)

Electronic mail allows you to very easily compose a message and send it electronically to the person in the office next door or to someone on the other side of the world. The receiver can reply you in the same easy manner.

E-mail is generally an organizations first Intranet application. It provides the opportunity to communicate from one person to another or to many people. (Hills, 1997, pg.11)

E-mail has two main parts in it: A header that contains information about the message and the body that contains the actual text of the message.

## **C. INTERNAL WEB**

The internal web is simply using Web tools inside the organization. It makes corporate information easy to access. All users have to know is how to use a mouse to point to click. If they can do that, then any information they need, can be available at their fingertips. With the addition of search tools to the internal web, if they can use a keyboard, the possibilities become almost endless. (Hills, 1997, pg. 12)

The main components in an internal web are web servers and browsers. Servers are already mentioned in network components section. Web servers are the powerful computers on which web pages reside.

The second component of the internal Web is the browser or client. The main function of the web browser is to act as a graphical user interface (GUI) between the user and the web server (Hill, 1997, pg. 13).

Those two components have a client-server relationship. Browsers act as clients and send requests of services to the server. Servers simply serve them by replying their requests by using HTTP protocol.

The most important feature of a browser is its user friendliness. It takes only a couple of minutes for even a computer illiterate to learn the basic operations.

Mosaic was the first browser that was created in 1993. One year later, in Dec.1994 the same group lead by Andreessen developed Netscape, which became a dominant product throughout the whole world in a short time. Soon after Microsoft realized the importance of the browser technology, they developed their Internet Explorer.

Currently there are other browsers on the market such as AOL, CompuServe and Prodigy. However Netscape and Internet Explorer are still the prevalent ones and they can be downloaded free.

The latest versions of these browsers have numerous features in them. Most of the web tools such as mailing lists, newsgroups, live audio and live video are embedded in them so that separate programs are no longer needed.

In addition to these built-in enhancements, there are plug-ins that can be added to a browser to do specialized things. See Appendix D for further information.

#### **D. MAILING LISTS**

Mailing lists are a way for groups of people to have public discussions via e-mail. After you join a mailing list, every message written, can be read by everyone on the list. Mailing list administrators are the ones who handle subscription to the lists upon user request via email message. Thus a new user is added to the database that keeps track of the e-mail addresses of the users on the list.

When the computer on which the database resides receives a message to be sent to the mailing list, it automatically mails the message to every address in the database. (Gralla, 1999, pg.86)

## **E. NEWSGROUPS**

Newsgroups are the public discussion groups in which anyone can participate. Many thousands of these groups focus on every subject conceivable. (Hills, 1997, pg.16)

Usenet is a good example of a newsgroup, which serves as a global bulletin board and discussion area. It collects messages about many thousands of different topics into newsgroups, which are freewheeling discussion areas in which anyone can participate.

There are two kinds of newsgroups: moderated newsgroups and unmoderated newsgroups. In a moderated newsgroup, a human moderator receives the messages and after selecting the appropriate ones, posts those on a newsgroup server. In an unmoderated newsgroup, all messages are put directly on the server. Newsgroups and all their messages are stored on Usenet servers that are organized by broad categories and then broken into specific topics. Some major topics are computers, alternate, social, science, recreation and news. Some more detailed examples are: (Gralla, 1999, pg. 99)

- comp.arch.storage
- rec.arts.books
- sci.astro.hubble
- news.announce.newsgroups
- soc.culture.afghanistan

## **F. CHAT**

One of the most immediate ways to communicate with others via the Internet or an Intranet is to participate in live chat. It is a conversation done by keyboards. After setting up a link to a person or a group, the words that you type are seen by the others immediately and vice versa. There are many software programs to chat, but Internet Relay Chat (IRC) is probably the most popular of all. (Gralla, 1999, pg. 103)

On an Intranet, chats can take the place of long-distance phone calls between locations. They allow you to communicate ideas more quickly than e-mail. Chats facilitate brainstorming sessions for participants who can convene at the same time, but not at the same place. You can schedule a chat about any topic of common interest and anyone can participate. You can also use chat for impromptu conversations. (Hills, 1997, pg.19)

## G. VIDEO-TELECONFERENCING

Seeing a person whom you are talking to via computers is an extremely valuable phenomenon in communication. Especially while expressing personal feelings, nothing can be better than seeing the correspondent and this is a great opportunity for collaborative works in companies.

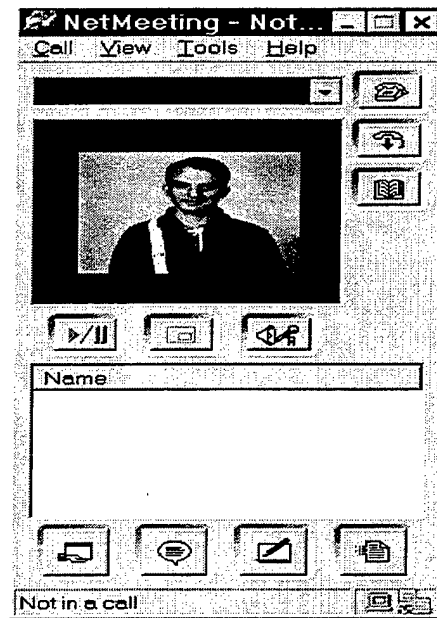


Figure 17. Video Teleconferencing

The high bandwidth rates in Intranets allow users to make clear video-teleconferencing. You don't have to buy special and expensive hardware and software programs for video-teleconferencing anymore. The only hardware you need is a web camera, which will not cost probably more than \$100. The required software can be downloaded free from the Internet.

## H. FTP

File transfer protocol (FTP) provides you a repository of information that is readily accessible. Anyone with FTP can log in to the repository and download what they need to their computer. FTP works well for transferring files that are too large to send by e-mail. (Hills, 1997)

Suppose that you are attending a meeting far from your company that will last a couple of days. You can reach your files at work any time you want. You can transfer files back and forth from your portable computer to your company. Thus you don't have to make long distance calls lasting hours or use fax machine spending hours on it.

When compared to email, FTP is much faster. Also, you need to contact to someone or make a request in advance, to receive your files. If you use FTP, you don't need anybody else, except a running server in your company.

The only pitfall was that, you had to know how to use some of the ftp commands. They are MS-DOS based commands and are not user friendly. However, currently there are user friendly programs like WS-FTP95 and you don't have to memorize the commands anymore.

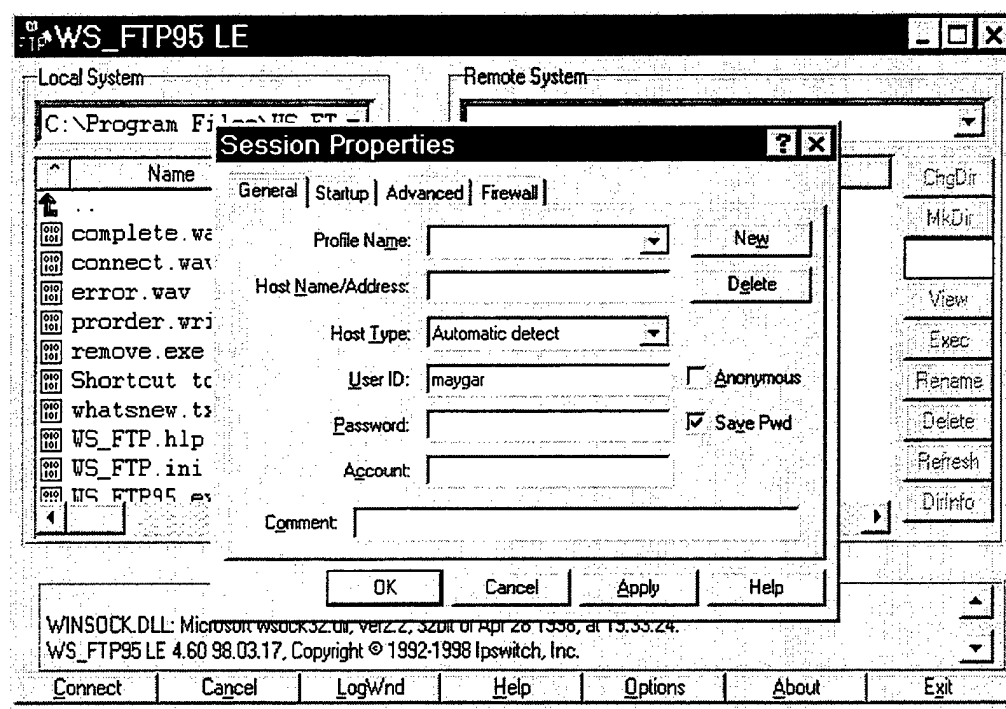


Figure 18. FTP Session

## **I. GOPHER AND WWW**

In the early days of the Internet, due to the enormous amount of data, a special software program, called Internet Gopher, was developed.

A Gopher organizes information in a logical fashion to lead you to files, Internet resources, data and anything else you might search for on the Internet. They were the first client software programs to allow access to many types of protocols and servers from within one client. There are still some Gophers located on the Internet but only some of the universities use them for internal use by employees or students (Gralla, 1999, pg. 119)

With the advent of the World Wide Web, Gopher lost its popularity. You can find user friendly search engines in the WWW. Most popular search engines are:

- Excite
- Netscape Search
- Infoseek
- HotBot
- Altavista
- Google
- Snap
- Lycos
- LookSmart

There are software programs, specifically written as search tools in Intranets and you don't need a gopher server in your Intranet.

## **J. TELNET**

Telnet is a command and program that lets you use the resources of a distant computer.

From your own home or office, you can log onto another computer, issue commands just as if you were at that computer's keyboard, and then gain access to all the computer's resources. To use Telnet and the host's resources, you need to know the address of the Internet host whose resources you want to access. (Gralla, 1999, pg. 123)

Figure 21 is an example for a telnet session.

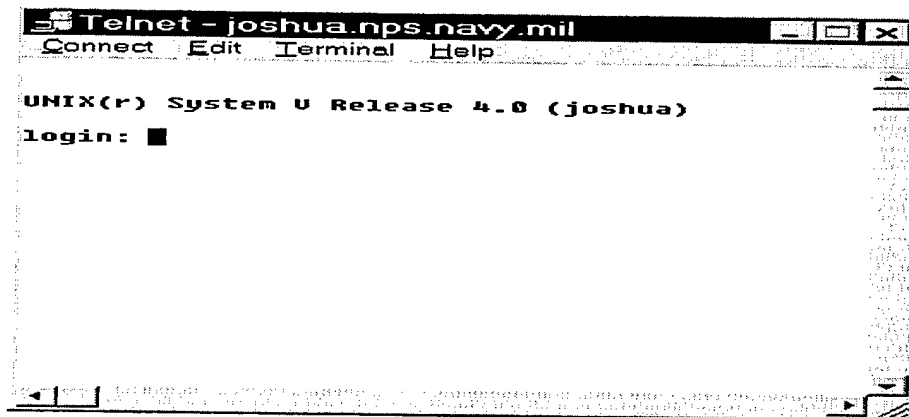


Figure 19. Telnet Session

## K. INSTANT MESSAGING

Instant Messaging is another type of communications service that enables you to create a private chat room with another individual. You can create your own list of friends or point of contacts. The system alerts you whenever somebody on your list is online. You can then initiate a chat session with that particular individual

There are several competing instant messaging systems. Unfortunately, there's no standard, so both parties must use the same software to send messages to each other.

Netscape AOL Instant Messaging and Ticker, which serves constantly updated news, are examples for this service. Figure 20 is an example for instant messaging.



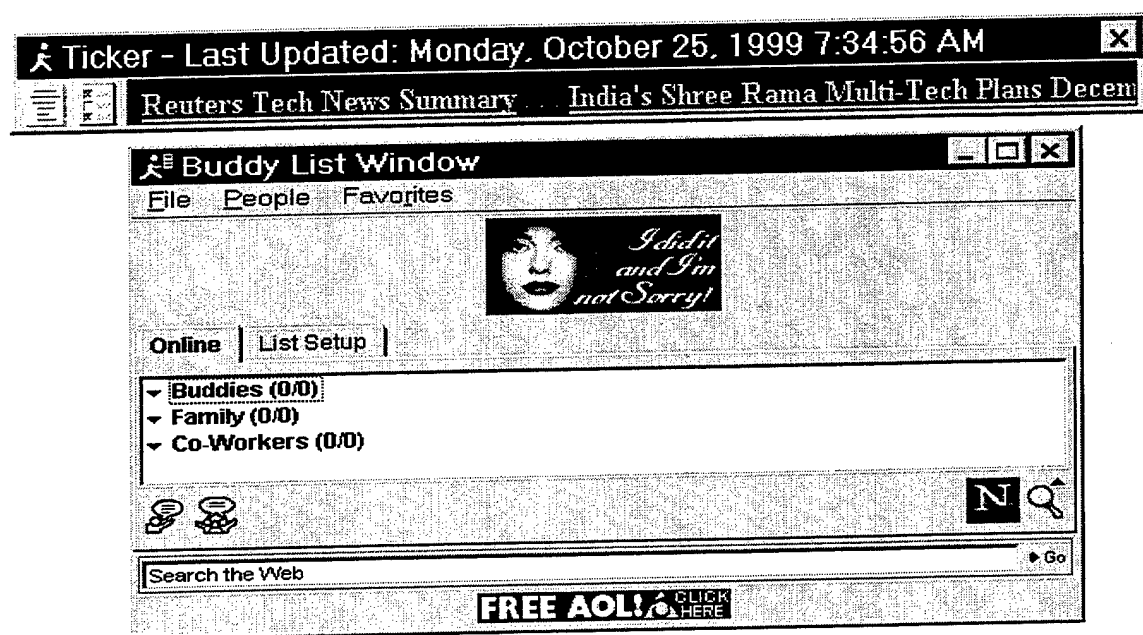


Figure 20. Instant Messaging

## **V. AIR DEFENSE ARTILLERY SCHOOL AND INTRANET**

### **A. INTRODUCTION**

#### **1. Background**

Air Defense Artillery (ADA) School is a combat arm school that has a three-year history.

ADA branch was disabled after World War II and the whole responsibility of the branch was given to the Artillery branch. However the rapid development of the aircraft industry and the undeniable military power of air force, caused the DoD to reevaluate the urgency of the ADA branch. Meanwhile the military operations taking place on different parts of the world, including the Operation Desert Storm through our neighborhood emphasized this urgency and soon after, ADA branch has been separated from the Artillery branch and reestablished as a new branch.

Providing training for the entire ADA branch, ADA school was established in 1997 and shortly after the establishment it moved to a new location in Istanbul, which is the largest city in Turkey. It is a mid-sized military organization, which supplies a variety of services with approximately three thousand personnel.

#### **2. Mission and Organization**

ADA School is the representative unit of all the ADA officer and NCO members of Turkish Land Forces Command (TLFC). Being the owner and having the responsibility of the branch, its missions are:

- Conducting and improving mission analysis in ADA field.
- Conducting research for improved means of education system in TLFC
- Prepare manuals related to ADA branch
- Offering necessary ADA courses for TLFC personnel

The primary mission of ADA School is to educate and train young officers and NCOs who will lead the air defense artillery units in the 21<sup>st</sup> century.

The following list shows the personnel groups that are trained and educated at the school:

- Young ADA officers who recently graduated from the military academy.
- Reserve officer candidates,
- NCO candidates
- Officers, NCOs and specialized merchants from the field to maintain and update their skills.
- Officers from foreign countries

ADA school also trains pilot applications in new technologies about air defense artillery. So, it is the first place for the latest acquired weapon systems to be tested.

There are six main units under the commandant: (See Appendix E for organization chart)

- Headquarters of Command :
- Supportings Unit Command
- Directorate of Academics
- Students and Course Unit
- Operations and Supportings Unit
- Conscript Training Unit

## **B. IT INFRASTRUCTURE**

Due to its recent establishment, ADA school has no network structure yet. As of Nov. 1999, there is an ongoing study to establish a LAN. However, because it is beyond the limits of this thesis, the author will not refer to the details of that LAN and will have an assumption that ADA school has a LAN established.

Currently each room in headquarters and other major sub units has at least one computer without any network connection. The personnel department maintains a standalone personnel database for the whole school.

Although some of the messages are delivered directly by phone, formally there is a very strict message delivery system. There are communication centers in major sub units and every formal paper to be sent or received has to be registered with those centers. At certain times of the day those messages are carried by a soldier from the communication centers to the one at ADA school center and vice versa. Bureaucracy and military hierarchy has brought an extensive paper work.

Fortunately most personnel are eager to learn computers, which is an important factor that will ease resistance.

### **C. WHY INTRANET?**

One of the strategic goals of this thesis is to provide an incentive for ADA school to embark on a new way of doing business by using the benefits of the information age and networked computers with applications like intranet. One way to succeed is to introduce functional, simple and easy to use computer technologies to the organization. Thus there will be a smooth transition phase and users will feel comfortable with the new change. Intranet technology is the perfect choice for its simplicity and ease of use.

These are the applications that the author will implement in ADA school intranet:

- Email: All users will have email addresses so that there will be no longer any time delay to deliver messages to personnel and even if the person is absent at that moment, sooner or later he/she will get the message. Absence will not be a problem anymore.
- What is new: The latest news and announcements such as the unscheduled meetings, or instant orders that the school commander gives, will be delivered to the entire organization without any delay.
- Database: This thesis will design and implement a personnel database for the school and connect it to the intranet so that whenever a user needs to get data, with respect to his/her authority and access right, it will be provided instantly. The latest connectivity technology will enable users to get the up-to-date data in the database.
- On-line publications: The most frequently used technical manuals and similar books will be saved electronically and accessed via intranet as online documents.
- Homepages: Each major sub-unit will have its own home page so that each of them can post specific information about themselves.
- Search: Users will be able to search both the intranet and the Internet for keywords or phrases. Especially project officers and instructors who are working on technical issues will benefit from this capability.
- Frequently Asked Questions (FAQ): All the major sub-units including the departments in the headquarters will post the frequently asked questions and

answers those are related to each of them. Thus people will first browse this page before attempting to ask any questions, which the author believes, will avoid those departments from explaining the same things to different people repeatedly.

- Phonebook: There will be an online version of a phone book, which will avoid publishing a new phone book each year.
- Visual aircraft recognition: Users will be able to learn nearly all the military aircraft in the world. Currently there is a course named "Visual Aircraft Recognition" at ADA school and this site will be a great visual aid as a course material. All kinds of aircraft will be presented with different kinds of images.
- Organization: This site will have an organization chart and information about each of the units in the chart in terms of their missions and functionality.
- Schedules: There are four levels of training schedules to be posted for all the units at the school: Yearly, quarterly, weekly and daily. This application itself will save tremendous amount of paper. Other schedules such as inspection schedules will be posted as well.
- Reports: This is another paper saving application. There are numerous reports sent from the units to the headquarters periodically, such as physical training reports (PTR) and reports about evaluation of all kinds of gun firing, sports, maintenance results and exercise.

Those are the applications that the author will implement, however they can be extended easily with regard to the creativeness of the users and new requirements at school.

#### **D. BENEFITS OF INTRANET FOR ADA SCHOOL**

The application list above more or less gives an idea about the benefits that ADA school will get. More specifically, the outcomes of an intranet for ADA school will be as follows:

##### **1. Improved Access to up-to-date Information**

The personnel database that is designed for ADA school intranet is accessible by everyone with regard to his/her authority. In the future some additional database like

logistics and operational database will be added to the intranet. Thus, users will be able to access up-to-date information within the organization. The users will also access any kind of announcement about the organization, instantly.

## **2. Cost Savings**

This intranet application will reduce the paper cost at ADA school. Even handling the training schedules on the intranet itself is worth about a cost reduction of thousands of sheets each week. In addition to training schedules, one senior NCO, who has worked at battery level headquarters for many years, has mentioned that they were using nearly 500 sheets of paper per week, for administrative staff and formal correspondences. See appendix F for detailed calculation.

Paper work can be transferred into intranet by having some adjustments in the organizational rules. On the other hand there are some discussions about the effectiveness of reading a paper and a screen. So, still there may be need to print some documents. However, even with those printouts, paper savings will be major cost savings for ADA school.

## **3. Time Savings**

Instead of using phone lines, which are sometimes busy, users will use their keyboards. Even if the contact person is not in his office, users will be able to send email and make sure that they deliver their message.

## **4. Improved Productivity**

The faster communication of information and a more intuitive user interface will improve people's comprehension. In the short run, the personnel department in the headquarters will no longer deal with routine processes and spend their time by answering user questions. Instead, they will have more time to work on better personnel policies and problems. Later on other departments will benefit the same gains by adding their applications to the ADA school intranet.

On the other side, there may be productivity decrease of the users. Especially, most users will surf through the non-job-related sites in the Internet wasting their time. Although there are some technical ways to avoid this event like monitoring the web sites that the users visit, it is impossible to end it, unless you cut the Internet connection to the

outer world. Even if there is no Internet connection, users will still spend their time surfing on the intranet. This is a trade off using such a technology.

## **5. Improved Decision Making**

Intranets provide timely access to people and information in order to help you make better decisions. With an intranet, the answers to most questions are at your fingertips and you can act quickly to make a decision. Decisions based on facts will inevitably be better than those made without facts. (Hills, 1997, pg.58)

## **6. Improved Communication**

The communication within the organization will be enhanced in these terms:

- **Speed:** The on-line ADA school intranet will be faster than the traditional phone communication
- **Comprehension and consistency:** Messages will not be delivered by second or third hand parties. Instead, whoever the source is, he will be able to communicate to the users directly with intuitive interface. Thus the message will be easier to understand.
- **Free flow of information and cross-organization:** There will be free-flowing conversations between different branches at the school. This will enhance the informal relationships.
- **Availability:** Any kind of information will be available to any person at any time no matter where he is. There will be access restrictions due to security concerns.

## **7. Enabled Sharing of Knowledge and Collaboration**

ADA school involves in numerous projects about the concept of ADA usage at the field and the instructors work on those projects in addition to teaching. School intranet will be a good way for them to share their knowledge with each other and collaborate with the other project members.

## **8. Empowered People**

Intranets make it easy for leaders to share their vision. When people have access to information and share the vision, they have a powerful yardstick by which to measure their decisions and to take action. (Hills, 1997, pg 62)

## **9. Facilitates Organizational Learning**

On-line training programs such as visual aircraft recognition are opportunities for users to learn without time or location constraints. Frequently asked questions page is also a good way of learning. Later on, frequently used manuals will be accessed via the school intranet making learning easier and faster.

## **10. Improves the Quality of Life at Work**

With all the benefits listed so far, users will change the way they work Especially the improvements in communication will make their life better.



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## **VI. MANAGING CHANGE**

The author believes that the application of the prototype of this thesis will change the way of business that has been carried out for many years. ADA school intranet will initiate a new transformation for the organization from manual world to a digitized world. Of course this thesis is not big enough to change the organization structure completely, however there are lots of strategic size projects that Turkish Military has been working on and they all contain the rules of new information age. Sooner or later smaller units will have to embrace the usage of new computer technologies in their organizations. So this intranet is a good opportunity for ADA school to jump ahead.

Despite the full support of the school commander, there will be resistance to new application and it is not unusual, more or less, people have always resisted changes in their life.

These are the steps that the author will follow to manage change while implementing the intranet at ADA School:

- Find a champion
- Deal with resistance to change
- Choose a change strategy
- Prepare a clear implementation plan within the chosen change strategy.

### **A. CHAMPION**

The first step of managing change is to find a champion to boost the idea. A champion is the person who has the power and authority to promote the project. In business organizations, that person is usually the CEO of the organization. In our case it is the ADA School Commander. Without his support, it would be impossible to implement an intranet at school.

### **B. RESISTANCE TO CHANGE**

Kotter and Schlesinger, 1979, define four common reasons that people resist change:

### **1. Parochial Self-interest**

People think that they are going to lose something of value which causes resistance that often results in politics or political behavior. Eventually power struggles began within an organization.

Although initiators of power struggles are sometimes scheming individuals, more often than not they are people who view their potential loss from change as an unfair violation of their implicit, or psychological, contract with the organization (Schein, 1965,pg.44)

### **2. Misunderstanding and Lack of Trust**

People also resist change when they do not understand its implications and perceive that it might cost them much more than they will gain.

### **3. Different Assessments**

People assess the situation differently from their managers or those initiating the change and see more costs than benefits resulting from the change, not only for themselves but for their company as well.

### **4. Low Tolerance for Change**

People will fear that they will not be able to develop the new skills and behavior that will be required of them. Drucker, 1954, has argued that the major obstacle to organizational growth is managers' inability to change their attitudes and behavior as rapidly as their organizations require. (Kotter and Schlesinger, 1979)

## **C. METHODS FOR DEALING WITH RESISTANCE TO CHANGE**

Kotter and Schlesinger, 1979, introduce six methods for dealing with resistance to change:

### **1. Education and Communication**

One of the most common ways to overcome resistance to change is to educate people about it beforehand. Communication of ideas helps people see the need for and the logic of a change. The education process can involve one-on-one discussions to groups, or memos and reports.

### **2. Participation and Involvement**

If the initiators involve the potential resistors in some aspect of the design and implementation of the change, they can often forestall resistance. With a participative change effort, the initiators listen to the people the change involves and use their advice.

### **3. Facilitation and Support**

Another way that managers can deal with potential resistance to change is by being supportive. This process might include providing training in new skills or giving employees time off after a demanding period or simply listening and providing emotional support.

### **4. Negotiation and Agreement**

This method offers incentives to active or potential resistors. It is particularly appropriate when someone going to lose out as a result of change and his or her power to resist is significant.

### **5. Manipulation and Co-optation**

Manipulation involves the very selective use of information and the conscious structuring of events. Co-opting is a common form of manipulation. Co-opting an individual usually involves giving him or her a desirable role in the design or implementation of the change. Co-opting a group involves giving one of its leaders, or someone it respects, a key role in the design or implementation of a change.

## **6. Explicit and Implicit Coercion**

In this method, managers essentially force people to accept a change by explicitly or implicitly threatening them (with the loss of jobs, promotion possibilities, and so forth) or by actually firing or transferring them.

All of those methods have unique characteristics, which makes it difficult to apply only one of them per any change instance. Instead having a combination of those will provide a better solution.

The best combination for ADA school intranet implementation is using mostly the education-communication method and rarely the explicit-implicit coercion method. Appendix G offers a detailed comparison for all those methods.

## **D. CHANGE STRATEGIES**

There are currently three well-known change strategies:

- Empirical-rational strategy
- Power-coercive strategy
- Normative-reeducative strategy

The empirical-rational strategy involves the information transfer from change agent, who is responsible for carrying out the change process, to the change target who is generally the end user like a worker or an officer in a organization. There is a professor-student relationship in this strategy. The power-coercive strategy assumes the management has the necessary power and the authority to make the change target accept the change. Military organizations are the typical application field for this strategy.

The normative-reeducative strategy denies the absolute power of the management and believes in the power of negotiation and participation.

Advanced change theory is an emerging strategy in addition to those three strategies. This strategy finds weaknesses in each of the prior strategies and defines its own assumptions to overcome those weaknesses.

While the first two strategies are quick to implement, it takes more time to implement the later two strategies. This is one of the reasons that the first two ones are the most widely employed strategies.

Whether to implement a fast and quick change strategy or slow and more comprehensive strategy depends on some factors. Table 3 can be used to decide what strategy to choose:

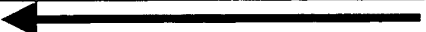

	
<b>FASTER IMPLEMENTATION</b>	<b>SLOWER IMPLEMENTATION</b>
Clearly planned	Not clearly planned at the beginning
Little involvement of others	More involvement of others
Attempt to overcome any resistance	Attempt to minimize any resistance
<b>Key Situational Variables</b>	
The amount and type of resistance anticipated	
The position of the initiators vis-à-vis the resistors (in terms of power, trust etc.)	
The locus of relevant data for designing the change and of needed energy for implementing it.	
The stakes involved (e.g., the presence or lack of presence of a crisis, the consequences of resistance and lack of change).	

Table 3. Change Implementation "After Kotter and Schlesinger, 1979"

The key situational variables are the factors to place the change effort on the continuum.

### 1. The Amount and Type of Resistance Anticipated

All other factors being equal, the greater the anticipated resistance, the more difficult it will be simply to overwhelm it, and the more a manager will need to move toward the right on the continuum to find ways to reduce some of it.

ADA school personnel seem to be eager to use new technologies, so hopefully extreme resistance is not anticipated.

### 2. The Position of the Initiator Vis-à-Vis the Resistors

The less power the initiator has with respect to others, the more the initiating manager must move to the right on the continuum. (Kotter and Schlesinger, 1979)

Although the rank of the initiator at ADA school will be low, the full support of the champion will lessen the negative affect of this factor.

### **3. The Person Who has the Relevant data for Designing the Change**

The more the initiators anticipate that they will need information and commitment from others to help design and implement the change, the more they must move to the right. (Kotter and Schlesinger, 1979) Due to the size and content of the application, the implementation doesn't involve too many people. Thus all the work can be done by an intranet team that will consist of a couple of school personnel.

### **4. The Stakes Involved**

The greater the short-run potential for risks to organizational performance and survival if the present situation is not changed, the more one must move to the left. (Kotter and Schlesinger, 1979) The intranet application doesn't necessarily cease the daily ongoing operations, so it doesn't have a potential risk for survival.

With regard to all of the four factors, it seems that the implementation of change strategy that will be adapted at ADA school will be on the left side of the continuum.

## **E. IMPLEMENTATION PLAN**

The author believes that, the eagerness and good will of the personnel, the military structure of the organization and the full support of the school commander will make it easier to apply the new intranet application at ADA school. Kotter's, eight steps to transformation will be our guideline.

### **1. Establishing a Sense of Urgency**

A great amount of personnel at the organization should be convinced that they need change. Potential crises and major opportunities are some of the ways to convince them.

Sooner or later ADA school will have to adopt the intranet-like computer technologies to meet the strategic-sized C<sup>4</sup>I projects' requirements on which TLFC has been working. So ADA intranet will be a major opportunity for ADA school to begin a new way of doing business.

## **2. Forming a Powerful Guiding Coalition**

A team of three to five people should be formed. It is essential that the team have the enough power to act. Therefore including the most senior officer at the headquarters of ADA school or some of the department heads like personnel officer would be helpful.

## **3. Creating a Vision**

This guiding coalition will develop a picture of the future that is relatively easy to communicate and appeal to whole personnel at school. This will be a statement that will clarify the direction in which the school needs to move.

The possible vision for ADA school is to bring all the applications at school whether it is administrative or operational to on-line, without diverting from simplicity and cost-effectiveness.

## **4. Communicating the Vision**

This step can be succeeded by arranging a series of meetings and conferences with different levels of attendees. Finally the team will talk to the whole school personnel. These meetings and conferences are perfect opportunities for convincing demos of the intranet. Some of the features of the school intranet can be shown to the attendees.

## **5. Empowering Others to Act on the Vision**

This step includes getting rid of the obstacles to change, changing systems or structures that seriously undermines the vision and encouraging risk taking and non-traditional ideas, activities, and actions ( Kotter and Schlesinger, 1979).

Once the vision is understood by all the personnel, there should be an intense course period through out the whole school that will cover basic computer skills.

## **6. Planning for and Creating Short-Term Wins**

There needs to be a planning for visible performance improvements that should be created soon. After the accomplishments, the personnel involved in these improvements will be recognized and rewarded.



## **7. Consolidating Improvements and Producing Still More Change**

The process should be reinvigorated with new projects, themes, and change agents.

The best part of the intranet is that there is no limit for new applications. It completely depends on the creativity of the people at the organization. So, by the time the users begin to capture the benefits of the intranet, they will begin to offer lots of new applications to implement.

## **8. Institutionalizing New Approaches**

In the final step, change sticks when it becomes “ the way we do things around here, “ when it seeps into the bloodstream of the organization body. Until new behaviors are rooted in social norms and shared values, they are subject to degradation as soon as the pressure for change is removed ( Kotter and Schlesinger, 1979).

## **VII. ANALYSIS OF ADA SCHOOL INTRANET**

### **A. INTRODUCTION**

Hardware and software are the two major components at ADA school intranet. Hopefully if you are going to build an intranet upon an existing LAN, you will not need any additional hardware. Due to the assumption that ADA school has a LAN, the author will not consider any cost analysis related to hardware. One powerful server machine can host more than one service like network operating system, web server, database server, mail server and ftp server.

However, most of the time, many organizations prefer to use different machines to host different services for security concerns. Especially, potentially insecure web servers which make the organization vulnerable to attacks from the Internet. If you have only one server machine hosting all the services, outsiders can penetrate your network and databases by using malicious software programs on your web server. To avoid this, usually web servers are hosted at separate machines.

For the moment ADA school intranet will have only one server machine to host all the services, because the scale of the application will not be too large. Also, having a project that requires a low budget will help the change initiator to manage resistance and change. When the users at school get use to intranet and some new applications are adopted, new machines may be added to lessen the burden of work on one machine.

### **B. HARDWARE**

The basic hardware components in an intranet are :

- One or more powerful server machines to host network operating system and other server software like web server, mail server, database server and ftp server
- Personal computers for end users
- Network interface cards for each of the personal computers
- Cabling for networking
- Hubs
- Peripheral devices: Printers, scanners, web cameras etc.

In each computer, central processing unit (CPU), random access memory (RAM) and hard drive capacity are the most important parts to be specified. However it is futile to specify and insist on detailed hardware standards as it difficult to keep up with the fast improving hardware technology. By the time this thesis is published, probably the features mentioned here will be out of date.

Table 4 shows the prices of the personal computers those are capable enough to run on an intranet as of the end of 1999, while Table 5 shows the prices of the server machines.

#### PC PRICES

MANUFACTURER	CPU	RAM (MB)	HD (MB)	PRICES ( \$ )
Acer 2100	P- II 350 MHz	32	6.4	847
Acer 8000	P- II 350 MHz	64	8.4	999
Compaq Deskpro EN	P- II 350 MHz	64	6.4	749
IBM 300 GL	P- II 350 MHz	64	4.2	1179
HP VECTRA VL8	P- II 350 MHz	64	4.3	1302
Acer 4100	P- II 400 MHz	96	6.4	867
Compaq Deskpro EN	P- II 400 MHz	64	6.4	1139
HP NETVECTRA N30	P- II 400 MHz	64	4.3	1309
IBM 300 GL	P- II 400 MHz	64	6.4	1254

Table 4. PC Prices. "From <http://www.zdnet.net>, 25NOV.1999"

### SERVER PRICES

MANUFACTURER	CPU (MHz)	RAM (MB)	HD (GB)	PRICES ( \$ )
Acer, Altos 21000	P-II 450Xeon	128	9.1	7269
Compaq,ProLiant 3000R	P- III 500	256	6.4	6110
Compaq,ProLiant 300R	P- III 500	128	4	3762
Dell, PowerEdge 2400	P- III	128	6.4	4814
HP, Netserver E60	P- III 550	64	9.1	2270
HP, Netserver LH4	P- III 500	256	-	8485
IBM, Netfin 5500 M10	P-III 450	128	-	6237
IBM, Netfin 5000 M10	P-III 500	128	-	3019

Table 5. Server Prices. . From ( <http://www.zdnet.net>, 25NOV.1999)

### C. SOFTWARE

The major software components in ADA school intranet are:

- Operating system
- Web server
- Web browser
- Database
- Middleware and Dynamic Web Pages

#### 1. Operating System

Network operating system has already been mentioned in chapter IV. In that chapter, the author has discussed the functionality of the operating systems and has briefly compared the most three common server operating system software with each other :

- Microsoft's Windows NT Server
- Novell's Netware
- Unix

The operating system that will be used at ADA school will be Windows NT Server version 4.0.

Windows NT Server is optimized for use as a file, print, and application server that can handle tasks for organizations from small workgroups to enterprise networks. (Microsoft Press, 1998, pg. 5)

Microsoft has introduced a new version of NT, which is called Windows 2000 in Feb 2000. However, until the new version is tested and widely accepted by the enterprise and proves its reliability, ADA school will use version 4.0.

## **2. Web Server**

A web server is a software program, which runs all the time, waiting to make connections and serves documents to the intranet users who ask for them. Every web page that is served in either the Internet or intranets must reside on a web server. When a user asks for a web page, he or she actually makes a request to the web server software. The server software captures the request, processes it by finding the appropriate web page and returns that page to the user.

There are many web servers off the shelf and some are even free. See Appendix H for detailed information about various web servers and prices. The most common web servers are:

- Microsoft Internet Information Server
- Microsoft Windows NT Workstation Personal Web Server
- Netscape FastTrack Server
- Netscape Enterprise Server
- Apache

Released in early 1996 and now bundled with Microsoft's NT Server 4.0, Internet Information Server ( IIS) is a powerful web server that is closely integrated with NT Server's operating system security controls, including user and group accounts and file and directory permissions. Although IIS is advertised as being free, you must first purchase a copy of Windows NT Server 4.0.( Coleman and Dyson, 1997, pg. 114)

Microsoft Windows NT Workstation Personal web server is a lighter version of IIS. Despite some of the features that are removed from this server, it is still a good choice for small size intranets.

Netscape FastTrack Server is a popular server you can use to get your intranet up and running fast. With Secure Socket Layer ( SSL) 3.0 - security feature, Navigator Gold

page-authoring tool, extensive server-level access control, and excellent performance, this server is hard to beat and has the sales history to prove it. (Coleman and Dyson, 1997, pg. 115).

Netscape Enterprise Server is another high-performance, enterprise-strength Web server. It offers some additional features when compared to the FastTrack. The latest version 4.0, has an advanced content management for end users with an approach called "Netshare". This feature of the server gives end users the ability to manage their own content. Services include Web publishing, access and version control, agent services, and link management. Netshare facilitates group collaboration as multiple users may publish pages to a server; edit, share, or collaborate on creating a document; and control access to their documents, all without needing a system administrator to intervene. Especially for the large intranets, the centralized management feature is very useful.

Apache is the most popular web server at the moment. It has no charge and has an open source code that is distributed freely. Its reliability, robustness and outstanding performance make many of the users choose this server against the software giants like Microsoft and Netscape. Although it was originally designed to run on Unix operating systems, the latest version 1.3.0 can run on both Unix and Windows NT.

Netcraft has recently published a survey result about the market share of the most popular web servers. They received responses from 8,844,573 web sites and survey results are given in figure 23.

According to this survey the market share list is :

1. Apache
2. Microsoft
3. Other developers
4. Netscape
5. NCSA. This is another popular, but unsupported and somewhat outdated web server

Market share for each product is given in the following figure.

DEVELOPER	OCT. 1999	PERCENT	NOV. 1999	PERCENT	CHANGE
Apache	4355658	53.67	4847992	54.81	1.14
Microsoft	2023591	24.93	2145461	24.26	-0.67
Netscape	627571	7.73	653800	7.39	-0.34

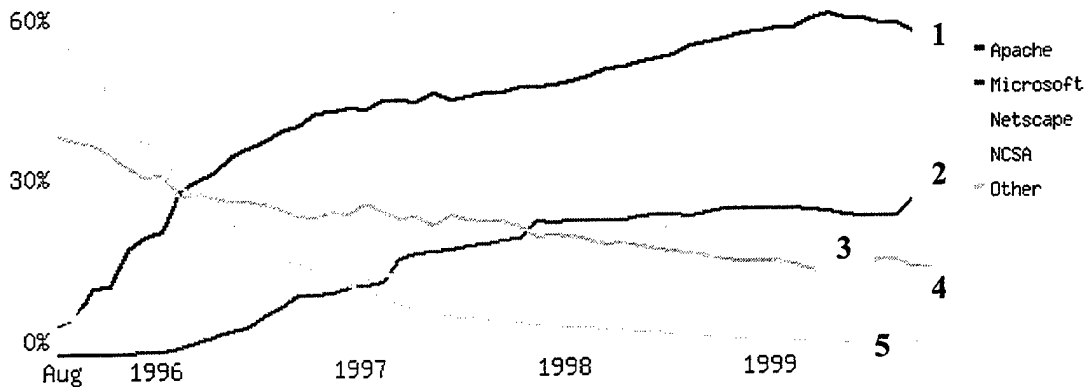


Figure 21. Market Share of Web Servers. "From <http://www.netcraft.com/survey/> "

The web server choice for ADA school intranet will be Microsoft Internet Information Server.

### 3. Web Browser

As described in chapter IV, a web browser is a software program which acts as a graphical user interface (GUI) between the user and the web server. Today, the success and wide acceptance of the browsers lie on the their ease of use. Being the most visible element in the intranet makes them even more important.

Although there are many browsers available, two of them are the most popular ones: Netscape Communicator and Microsoft's Internet Explorer. These latest browsers have very advanced features like vivid graphics capabilities, tables, forms and other multi media features. In addition to those, today many software products can either be plugged in to these browsers or they are already embedded in them. See Appendix D, plug ins for detail information

Both Netscape and Internet Explorer can be downloaded without any charge. However it would be more efficient to use only one kind of browser in an intranet,

because each of the browsers may display the same web page slightly in a different way. Besides, using the same browser in the whole organization will bring standardization and enable users to orient to their workplace with their new assignments.

The author will use Microsoft Internet Explorer for ADA school intranet, because it will easily integrate with the web server and operating system which are both Microsoft products.

#### **4. Database**

This section will briefly explain the database and current popular database products. For further and detailed information about database, see appendix I.

A database is a collection of data that are somewhat related to each other. Data are organized into meaningful fields, records and tables so that they can be managed easier and more efficiently.

The software programs that manage these related data fields, records and tables are called database management systems (DBMS). Parallel to the improvements in computer technologies, DBMS products have evolved and are categorized by different architectures.

The initial phase began with file management systems, which stored data sequentially. In this model, you have to search all the stored data to reach the particular data you are looking for. Later, hierarchical database systems were developed to lessen the inefficiencies in the previous model. This model organized the data in a tree structure so that users could reach the data with less effort. Next model was the network database model, which brought some additional new features to the hierarchical database systems. The last model, called relational database system was completely different from previous models. This model defined tables with modular structures. Today this model is the most common and popular database system.

Another important milestone in database improvement has been the computer platforms that DBMS run on. Salemi, (1995) defines four categories or platforms for the DBMS architectures:

1. Centralized platforms
2. PC systems
3. Client-Server platforms
4. Distributed processing systems



Centralized platforms have powerful computers at central locations called mainframes. These mainframes run all the programs that are necessary to carry out the requirements within the system. End users connect to these powerful computers via terminals that are mostly dumb, with no or very little processing power.

PC systems are standalone personal computers that have the enough resources to run a DBMS. As long as there is a single user, these systems are both cost-effective and easy to learn. However they are not good at multi-user environments in which simultaneous transactions occur frequently.

Client-Server platforms are the most commonly used platforms. The principle of the working mechanism in the Internet is an example for this kind of platform. Users are the clients who make requests for service and special servers like web servers, file servers, and print servers listen to those requests and simply serve the information the clients need.

Distributed processing systems are more complicated forms of Client-Server platforms. A number of same databases are maintained over the network in different locations and they are synchronized with each other periodically to keep latest consistency.

Oracle is the dominant DBMS company on the market and their last product version Oracle8I, which is specifically developed for the Internet has very enhanced features enabling the seamless web integration. Informix, Sybase and Microsoft are some of the other companies that are involved in the database business. Microsoft has two DBMS products, that are widely used : MS SQL server and MS Access 97. While Access 97 is very popular for standalone databases and for limited number of users, SQL server has the ability to run more complex and large databases like an enterprise database.

The personnel database that ADA school intranet will host is initially designed by using Access 97. After numerous tests it will be upsized to SQL server via using a specific upsizing tool.

## **5. Middleware and Dynamic Web Pages**

As mentioned in the previous section, the main principle of the working mechanism in the Internet is related to client-server applications. See appendix J for detailed information. Having the same technical structure with the Internet, intranets also work with that principle.

Many applications that we use in the Internet and intranets involve database operations. When we log on to a web page, search the Internet or use a phone book in our intranet, actually we are interacting a database. Middleware is the software that enables us to do that. It resides on both server and client side of the architecture. Servers use middleware to connect to a database or to perform specific operations on the server side, while clients use middleware to receive information from the users and transfer it to the server.

Each time you buy a product from “www.amazon.com” or any other on-line store, without being aware you are experiencing database-connectivity over the Internet. In order to get the product, you need to fill in some forms to provide your personal information such as your name, address, and credit card number. This information is transferred to some kind of database and acts as input to additional applications.

There are various middleware technologies with very advanced capabilities. Some common ones are:

1. Common Gate Interface (CGI)
2. ColdFusion application
3. Active Server Pages

#### *a. CGI*

The first generation of web pages was mostly static or in other words, not interactive. Administrators who were responsible to maintain those web pages had a lot to do. It was unsatisfactory for the users as well as you couldn't get real-time information.

Improved technology enables us to create dynamic web pages from which you can get the latest information like the current values of stocks.

The dynamic structure is achieved by using small programs, called scripts. Those small programs do some magic and create the required HTML code for necessary applications. Furthermore, they present the outcome in the form that the web browser software can easily read.

The next step was to create a standard script interface so that the scripts can work on multiple web servers. That standard is called CGI. See appendix J for further information about CGI.

### ***b. ColdFusion Database Application***

ColdFusion is a rapid application development tool that enables the rapid creation of interactive, dynamic, and information-rich web sites. (Forta, 1998, pg 13.)

The best part of ColdFusion technology is that you don't have to learn a traditional programming language. It uses special tags defined by ColdFusion to manipulate the web pages by inserting into HTML codes.

These tags begin with "CF" and are easily distinguished by ColdFusion servers. The following is a sample ColdFusion code used for making a query.

```
<CFQUERY
DATASOURCE = "MYDATABASE"
>
INSERT INTO Employee ( FirstName, LastName, PhoneExtension)
VALUES ( '#FirstName#' , '#LastName#' , '#PhoneExtension#')
</CFQUERY>
<HTML>
<HEAD>
<TITLE> Employee Added </TITLE>
</HEAD>
<BODY>
<H1> Employee Added</H1>
<CFOUTPUT>
Employee <B>#FirstName# #LastName# </B> added.
</CFOUTPUT>
</BODY>
</HTML>
```

Allaire, the maker of ColdFusion defines the latest version of ColdFusion as ColdFusion Markup Language and Forta, 1998, lists the following capabilities extending HTML by adding tags :

- Read data from, and update data to, databases and tables
- Create dynamic data-driven pages
- Perform conditional processing

- Populate forms with live data
- Process form submissions
- Generate and retrieve email messages
- Interact with local files
- Perform HTTP and FTP operations
- Perform credit card verification and authorization
- Read and write client-side cookies

### *c. Active Server Pages*

Active Server Pages (ASP) are another way of creating dynamic web pages. Microsoft calls it neither a language like HTML nor an application like Word 97 or Excel. It is simply a technology for building dynamic and interactive web pages.

The main idea behind this technology is that because browsers are dealing with so many things that each day they are enriched by new services and of course, tasks. ASP uses web servers for execution, therefore providing simplicity and speed.

ASP was officially announced to the world by Microsoft on July 16, 1996, codenamed "Denali" and released in November 1996. It gained much wider recognition when it was bundled with version 3 of Microsoft's Internet Information Server Suite in March 1997, and has been gaining popularity steadily since then. (Francis, 1998, pg 7.)

The current version of ASP is 2.0 and mainly uses two scripting languages: JavaScript and VBScript. The following is a simple script written by VBScript language.

```
<html>
<head>
<title>Writing the Current Date to a Document with ASP Script</title>
</head>
<body BGCOLOR="WHITE">

<p>This is your first script example. Today's date is <script
LANGUAGE="VBSCRIPT"
RUNAT="SERVER">
Response.Write(Date)
```

```
</script> . </p>
```

```
</body>
```

```
</html>
```

and the outcome is :

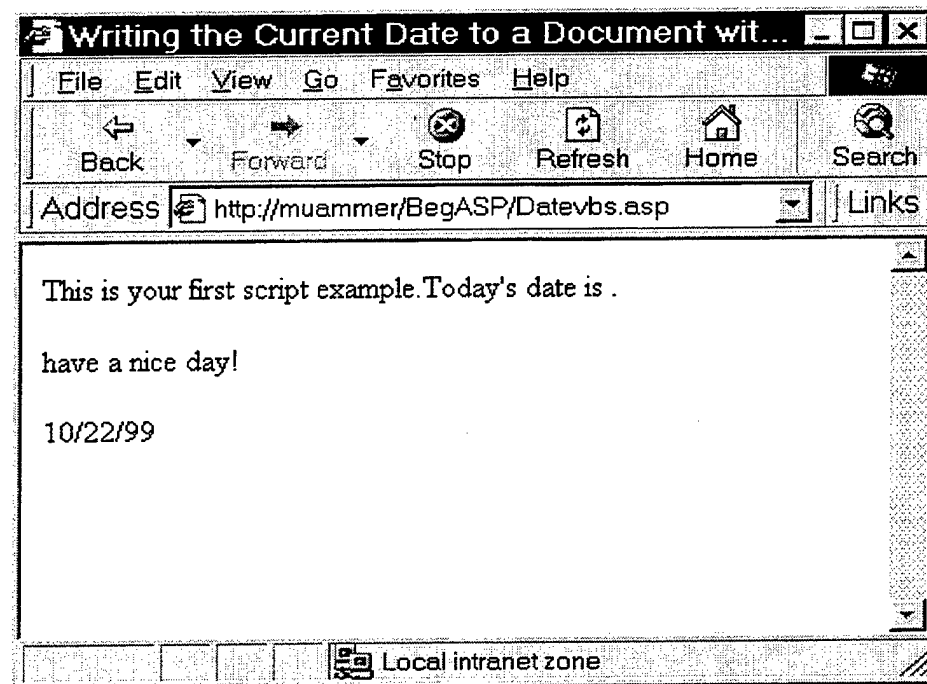


Figure 22. VBscript Output

There are six built-in objects in ASP:

- Request
- Response
- Application
- Session
- Server
- ObjectContext

The request object handles communications from the browser to the server and is mainly used to control how the user sends information to the server. The object

that deals with everything being sent from the web server to the client is called the response object.

The application object allows us to tie together all of the pages on a single site into a consistent web application and the session object allows us to treat a user's interaction with the web site as a continuous action, rather than just a disconnected series of page requests

Server and ObjectContext objects provide the users some additional features so that you don't need long line of codes for scripting any more.

Although ASP is more complex and more difficult to learn than the CGI or CodFusion, this thesis will use ASP technology for creating a prototype application for Air Defense Artillery School. By using the same company's products, the author aims at seamless integration between applications.

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## VIII. ADA SCHOOL INTRANET PROTOTYPE

### A. EXPLORING THE ADA INTRANET

#### 1. Main page

The first page that users see on the ADA school's intranet is the main page which as an entry gate that links to subordinate sites on the intranet.

Figure 23 shows the main page of the intranet with links buttons to other pages.

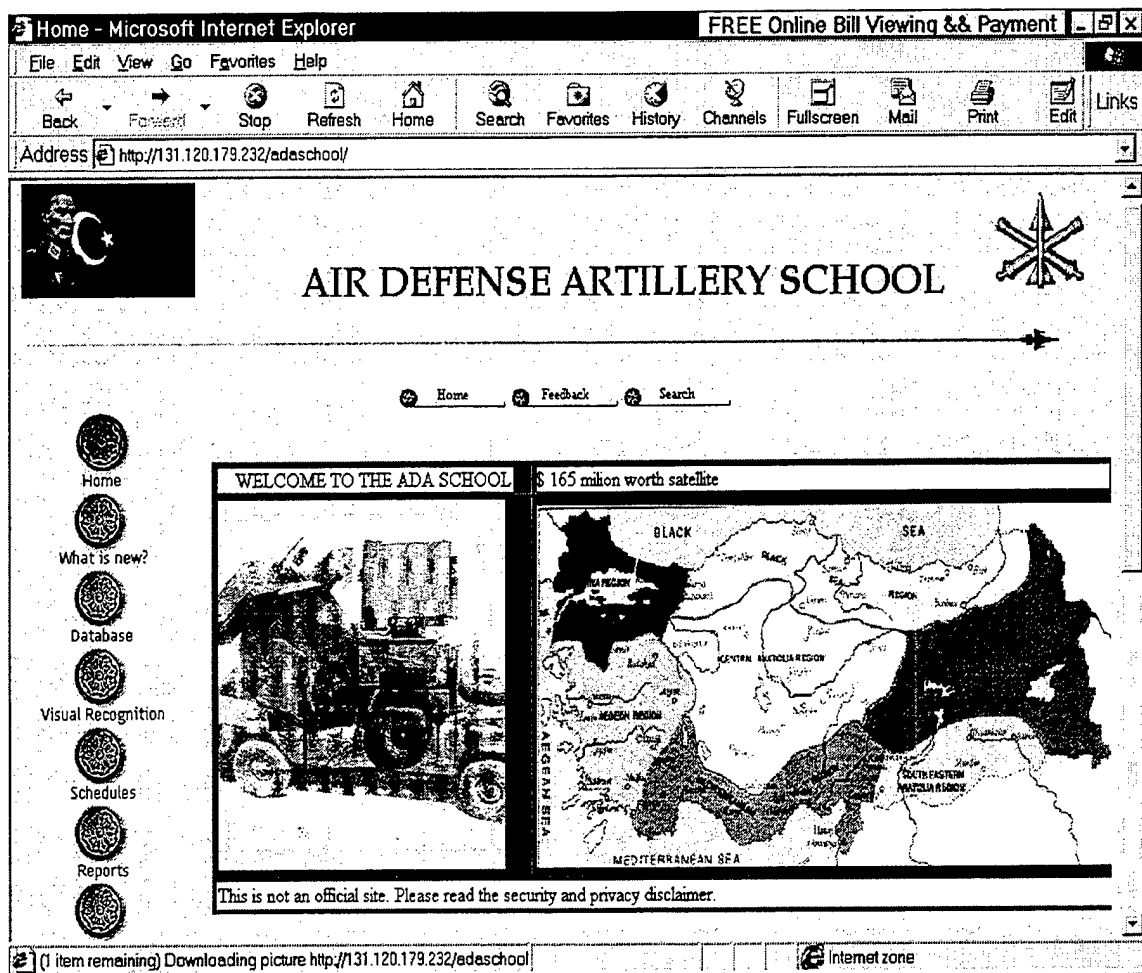


Figure 23. Main page



## 2. Database

The need for personnel database has been mentioned in Chapter I. The first step in designing a database is to determine user requirements. Thus, the author contacted the ADA school personnel office and obtained via email, the user forms and reports that are currently being used. Also, a personnel database is being created using Microsoft Access 97, which will be upgraded to SQL Server 7.0.

Figure 24 shows the relationship diagram, which represents the main database architecture.

According to this architecture, there is a "Person" object at the top that has the attributes of a person such as State ID, first name, last name, father's name, date of birth, place of birth, weight, height, color eyes etc.. This object is used as a template for all the other living objects at the school because each person, whether military or civilian, a child, a spouse or a dependent, possesses these attributes. Therefore they inherit the attributes of the Person object.

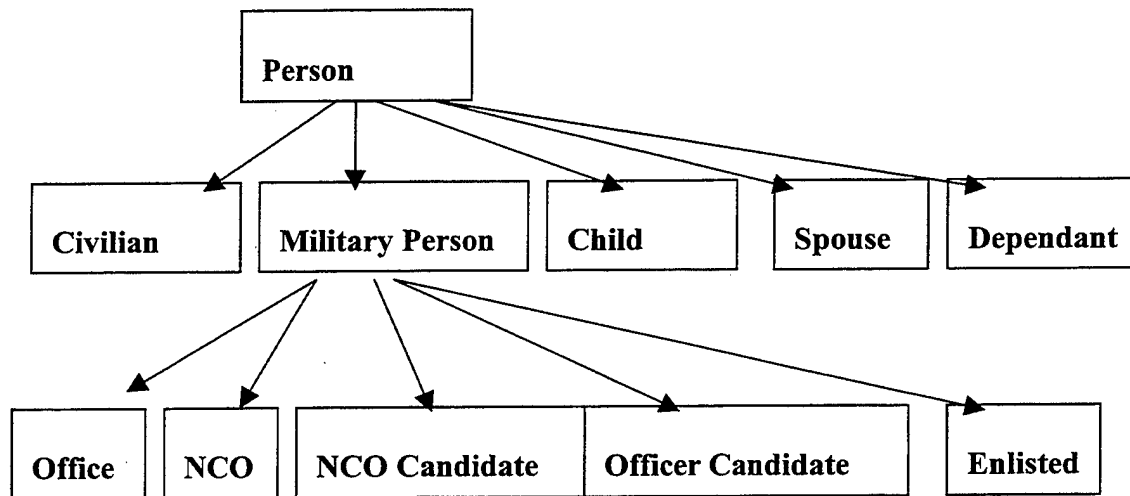


Figure 24. Main Database Architecture

In order to implement the relationships between each object, thirty-six tables were created. Figure 25 shows the detailed table information.



Figure 25. Database Tables

In addition to the NT Server security features, the author wrote a user authentication code by using Vbscript to tighten security. This code presents the users with a login page.

When the users enter their usernames and passwords, the authentication code searches a specific table called “Users” from the database. This table contains usernames and passwords. If both values match then the user is redirected to the main database section. If not, the user is asked to login again. Figure 26 shows the user’s login screen.

The screenshot shows a Microsoft Internet Explorer window titled "Login page - Microsoft Internet Explorer". The address bar displays "http://131.120.179.232/adaschool/database/Login.asp". The page header includes a logo on the left and the text "AIR DEFENSE ARTILLERY SCHOOL" in the center, with a star-like symbol on the right. Below the header, the page is titled "Login Page" and contains the instruction "Please enter your user name and password to login to the system." There are two input fields: "User name:" and "Password:". Below these fields are two buttons: "Login" and "Reset". The status bar at the bottom shows "Done" and "Internet zone".

Figure 26. Login Page

The main database section allows the user to view “Forms” section in which he or she can enter new data, update existing data or delete existing data. In the “Reports”

section, the user can view different kinds of reports of all the personnel in the database. The search section enables the users to make queries about various information about the personnel.

Figure 27 is a screen shot of the main database section of the intranet.

Results - Microsoft Internet Explorer

FREE Online Bill Viewing && Payment

File Edit View Go Favorites Help

Back Forward Stop Refresh Home Search Favorites History Channels Fullscreen Mail Print Edit Links

Address [http://131.120.179.232/adaschool/database/Main\\_Results.asp](http://131.120.179.232/adaschool/database/Main_Results.asp)

**FORMS**

**QUICK SEARCH (Enter the last name of the person)**

**HOME**

**NEW ENTRY**

Assignments Military Person?  
Awards Received Military Office  
Child? NCO Candidate?  
Civilian Workers Perm. Address  
Course Person  
Current Addresses Photos  
Dependency Info Promotions  
Email Info Punishments  
Enlisted? Research Survey  
Graduation Info Rest Info  
Hobbies State ID Info  
Instructors Spouse Info  
Foreign Language Uniform Info  
Licence Info Vehicle Info  
Mercenary? Weapon Info

StateIDNo  Reset

MilitaryIDNo  Reset

If you don't remember the last name exactly you can enter the first letters that you remember. e.g. "ayg" for aygar

You can get the results " StateIDNo", "MilitaryIDNo", and "Name" of a person or people

For more information push "Detail" button or click on the last name of the person

	State ID No	FirstName	LastName
<a href="#">Detail</a>	E08679955	Murat	<a href="#">AKBAY</a>
<a href="#">Detail</a>	E09679992	Unal	<a href="#">AKTAS</a>
<a href="#">Detail</a>	E09679994	Nevin	<a href="#">AKYOL</a>
<a href="#">Detail</a>	E09679993	Kadir	<a href="#">AKYOL</a>
<a href="#">Detail</a>	E09680008	Lale	<a href="#">ARSLAN</a>
<a href="#">Detail</a>	E09680007	Suat	<a href="#">ARSLAN</a>
<a href="#">Detail</a>	E09679000	Er	<a href="#">ASKER</a>
<a href="#">Detail</a>	E09680005	Tolga	<a href="#">AYAN</a>
<a href="#">Detail</a>	E09680109	Murat	<a href="#">AYGAR</a>

Done Internet zone

Figure 27. Main Database Section of the Intranet

The menu on the left-hand side offers the operations that were previously explained. The main sections are:

- Forms
  - New entry
  - Update
- Reports
- Search

Figure 28 shows the data entry for a child's information.

Results - Microsoft Internet Explorer      FREE Online Bill Viewing & Payment

File Edit View Go Favorites Help

Back Forward Stop Refresh Home Search Favorites History Channels Fullscreen Mail Print Edit Links

Address http://131.120.179.232/edaschool/database/Main\_Results.asp

**FORMS**

**NEW ENTRY**

Assignments Military Person?  
 Awards Received Military Office  
Child NCO Candidate?  
 Civilian Workers Perm. Address  
 Course Person  
 Current Addresses Photos  
 Dependency Info Promotions  
 Email Info Punishments  
 Enlisted? Research Survey  
 Graduation Info Rest Info  
 Hobbies State ID Info  
 Instructors Spouse Info  
 Foreign Language Uniform Info  
 Licence Info Vehicle Info  
 Mercenary? Weapon Info

**UPDATE**

**REPORTS**

**SEARCH**

**QUICK SEARCH (Enter the last name of the person)**

StateIDNo  If you don't remember the last name exactly you can enter the first letters that you remember. e.g. "ayg" for aygar

MilitaryIDNo  You can get the results " StateIDNo", "MilitaryIDNo", and "Name" of a person or people

**INSERT A NEW CHILD RECORD**

State ID No	<input type="text"/>
Age	<input type="text"/>
Current School Name	<input type="text"/>
Parent's StateIDNo	<input type="text"/>

**Warning!**

If you have no personal records related to this person, please use the "Person" option under "New Entry" and insert a personal record first.

Done Internet zone

Figure 28. Data Entry about a Child Record

### 3. Phone Book

The ADA school has a phonebook page used to search for any personnel at the school. The user does not need to know the exact name of the person. Clicking on the letter of an alphabetical list found at the top of the page will match the first letter of the person's name. Also, the user can enter the letters in the search text box at the bottom of the page and again find the person.

Once the data appears more detailed information about that person can be found by clicking on the "Detail" button or clicking on the person's last name.

Figure 29 shows an instance of a search for the letter "A" in the phonebook page.

main search form - Microsoft Internet Explorer      FREE Online Bill Viewing & Payment

File Edit View Go Favorites Help

Back Forward Stop Refresh Home Search Favorites History Channels Fullscreen Mail Print Edit Links

Address [http://muammer/HANCER/Phone/main\\_search\\_form.htm](http://muammer/HANCER/Phone/main_search_form.htm)

If you wish you can choose the first letter of the person's last name and see everybody whose names begin with that letter.  
OR you can enter the last name of the person, at the bottom of the page.

**A B C D E F G H I J K L M N O P Q R S T U V W X Y Z**      HOME

	LastName	FirstName	PhoneNo	PhoneExt
Detail	<a href="#">AKBAY</a>	Murat	(312) 356-5656	2220
Detail	<a href="#">AKTAS</a>	Unal		0
Detail	<a href="#">AKYOL</a>	Nevin		0
Detail	<a href="#">AKYOL</a>	Kadir		0
Detail	<a href="#">ARSLAN</a>	Lale		0
Detail	<a href="#">ARSLAN</a>	Suat		0
Detail	<a href="#">ASKER</a>	Er		0
Detail	<a href="#">AYAN</a>	Tolga		0
Detail	<a href="#">AYGAR</a>	Murat		0
Detail	<a href="#">AYGAR</a>	Gul		0

Search      If you don't remember the last name enter the first letters that you remember

Local intranet zone

Figure 29. ADA School Phone Book

#### 4. Discussion

The discussion page is open to everybody at the school. No password is required nor are there any other restrictions. A user can post a message by clicking on the "post" icon. Once the user submits the post, the posted message is displayed under "Contents" on the left-hand side of the page. However, in order to see the recently posted messages the user has to reload the current web page by clicking on either the "Refresh" button or "Reload" button depending on which browser he or she uses.

The user can also make a search for specific text in the previously posted messages by clicking on the "Search" icon. Figure 30 shows the main discussion page for ADA School intranet.

This discussion form was built with Microsoft FrontPage98.

The screenshot shows a web browser window titled "Frameset for ADA Discussion - Microsoft Internet Explorer". The address bar displays "http://muammer/HANCER/disc4\_frm.htm". The page content includes a header with a group of people and navigation buttons for HOME, SEARCH, and POST. Below the header, there are two main sections: "CONTENTS" on the left and "POST ARTICLE" on the right. The "CONTENTS" section lists two entries: "test2 Muammer AYGAR 1/8/00" and "test1 Muammer AYGAR 1/8/00". The "POST ARTICLE" section contains a form with fields for "Subject:", "From:", and "Comments:". Below the form are two buttons: "Post Article" and "Reset Form". The status bar at the bottom indicates "Opening page http://muammer/HANCER/disc4\_frm.htm..." and "Local intranet zone".

Figure 30. ADA School Discussion Form.

## 5. Search

This prototype intranet uses a FrontPage search engine that is composed of two parts. One part is responsible for indexing the content of the web pages and the other actually conducts the searches. The indexing portion of the search engine builds a dictionary of all the words in the documents that are included in text searches. This dictionary keys every word in its list to every instance of that word occurring in the documents.

In this manner, when a user searches for a keyword, the search engine goes to this dictionary to locate matches quickly. (Elderbrock, 1998, p.294)



ADASCHOOL Search Page - Microsoft Internet Explorer

FREE Online Bill Viewing & Payment

File Edit View Go Favorites Help


Back Forward Stop Refresh Home Search Favorites History Channels Fullscreen Mail Print Edit Links

Address [http://muammer/HANCER/\\_vi\\_bin/shhtml.dll/search.htm](http://muammer/HANCER/_vi_bin/shhtml.dll/search.htm)

 **AIR DEFENSE ARTILLERY SCHOOL** 

[Home](#) [Feedback](#) [Search](#)

Today is 01/21/00



Please enter the text or group of texts that you want to search.

Search for:

Number of documents found: 74. Click on a document to view it, or submit another search.

Search Results

Document Title	Date	Size
<a href="#">Home</a>	01/20/2000 00:19:36	11KB
<a href="#">Insert Email</a>	01/13/2000 23:18:40	7KB
<a href="#">Insert Email</a>	01/13/2000 23:22:42	5KB
<a href="#">Insert Child</a>	01/14/2000 00:10:56	7KB
<a href="#">Insert Course</a>	01/16/2000 02:01:26	7KB
<a href="#">New Page</a>	01/16/2000 17:18:42	2KB

Done Local intranet zone

Figure 31. ADA School Search



## **B. TRAINING AND MAINTENANCE**

Two kinds of user groups are involved in training. The first is the ordinary end users who just open their browsers and use them. The ease of using browsers does not necessitate further training on their part. The second group will maintain the database and administer the intranet content. They must be well-educated and well-versed in web topics.

There must be an intranet team to maintain the content. Hills, 1997, suggests the following positions as team members:

- Team leader: The representative of the champion who keeps communication flowing between the team, the champion and the steering committee. He or she has responsibility and authority to keep everything moving, resolve issues, and ensure that the team meets its goals.
- Web architects: They develop the structure and flow of the internal web.
- Web services: These people evaluate and select Internet and intranet tools, build web applications, train and support web publishers, and keep everyone up-to-date.
- Webmasters: They set up and administer web servers and maintain the content of those servers. Their role is to keep the team aware of capacity issues and what is being done in that area as well as changes that will affect the publishers of content.
- Programmers and applications developers: They hook the database to documents and develop Java applications.
- Graphic artists and designers: They develop the home pages and graphics for the internal web. They may create libraries of graphics, icons, bullets and navigational tools for use by all web publishers.
- Communicators: They are responsible for the image and message of the organization and for internal communications with employees.
- Web publishers: They generally come from all areas of the organization. They are responsible for developing and overseeing the content of their departmental web sites.
- Technical support: They help install TCP/IP, browsers and other applications for users.
- Trainers: They develop and deliver training for web publishers and end users.

- Help desk and support: They support the audience as it grows and should be brought into the planning phase early in the process.
- Legal: They deal primarily with the external Web site, but need to be aware of where the intranet interfaces with suppliers, customers or others outside the company.
- Facilitator: Plans for and runs the team meetings to ensure that they are as productive as possible.

Considering the human resources involved, this list is large for the ADA School. However, in the near future, all the combat arm schools will have their own intranets and the entire Turkish Land Forces Command will have a nationwide intranet. This list will then be helpful.

For now, a team of three will be enough to run the school's intranet:

- A Team leader
- A Webmaster
- A program and applications developer

Also, FrontPage 98 has a GUI for web site management. It has the capability to administer more than one site remotely. It will help the team maintain the school's intranet with limited resources.

The ADA School's intranet will be managed centrally. The team members will publish all the contents except the schedules and report sections. Each sub-unit will be responsible for maintaining their homepages, and update the sites hosting the reports and schedules.

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## **IX. SECURITY**

### **A. INTRODUCTION**

Security has always been of great concern for Internet users. Those who invented the Internet back in the early 70s could not predict the scope of its usage. Their focus was on academic and scientific studies. The basic protocols that are in use now, such as IP, are vulnerable to misuse and malicious attacks. As most of the intranets use the same Internet protocol suites, they are subjected to the same security vulnerabilities.

Today many corporate intranets connect to the Internet in order to interact with customers or because they have a physically distributed organization structure. If an intranet is connected to the Internet, there will be some security breaches to be dealt with. Security is easier to implement if the intranet is not connected to the Internet, and is only used to serve the organization itself.

With or without the Internet, an important security issue is user awareness. Users in an organization need to be aware of security threats and be trained periodically in accordance with the organization's security policy, guidelines and standards.

A security policy is a brief high level statement that indicates the intention of the organization's management. Guidelines are suggestions about how to achieve the policy's goals and obtain compliance with more specific standards. Standards are the instructions, which describe the users, and how to maintain security. Users must comply with these instructions.

### **B. INTRANET SECURITY**

We can define the main security topics in an intranet as follows:

- Network security
- Server security
- Encryption and Secure Socket Layer
- User awareness

## 1. Network Security

A network is the main component of an intranet and most security problems can be solved with a well designed network architecture. People both outside and inside an intranet are the sources of attacks. Intranets connected to the Internet are vulnerable to outsider attacks. A disgruntled employee, for example, is more dangerous than someone outside the organization because of intimate knowledge of the intranet and the organization.

The safest network architecture for an intranet connected to the Internet physically isolates the web server from the intranet. This is also called air gap security.

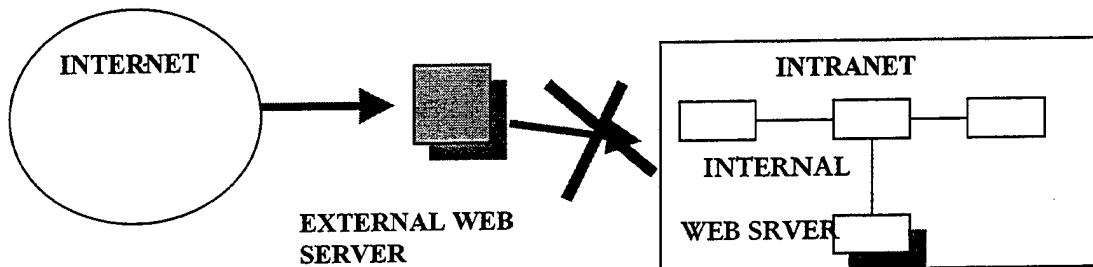


Figure 32. Air Gap Security

Although this is a safe implementation, as seen in Figure 32, it limits the capabilities of the intranet. Instead, most organizations use the following architecture.

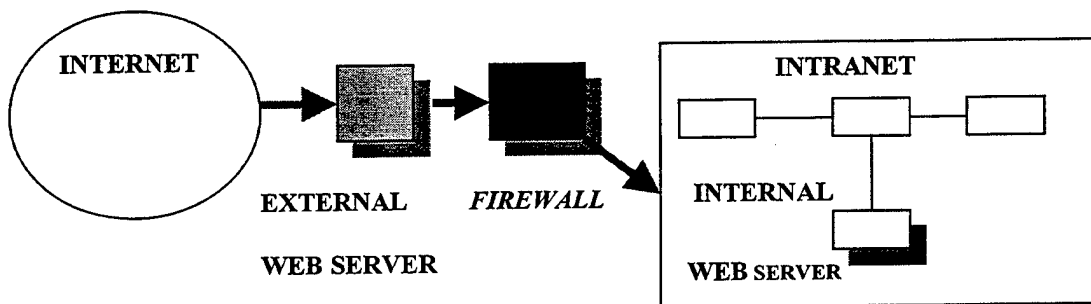


Figure 33. Connection with Firewall

A firewall is a software and hardware combination used to avoid intrusions from the Internet. Many routers now function as firewalls, which allow information flowing through the firewall to be restricted by type (for instance, only HTTP or FTP information) or IP addresses of the computers. Firewalls are the best way to protect a network from intrusion via the Internet but there is still no guarantee. (Strebe and Perkins, 1998, pg. 59)

Another way to secure networks against the Internet is protocol isolation. In this model, the external web server can be accessed by both intranet and Internet users. The basic idea is that the protocols used on the Internet and intranet sides are different from each other. Therefore, Internet users cannot access the organization's intranet. Despite the limited capabilities, intranet users can still copy files and maintain the server by using a specific protocol. In Figure 34, TCP/IP is the basic protocol used on the Internet side while IPX( the protocol used in Novell NetWare networks) is the basic protocol used on the intranet side.

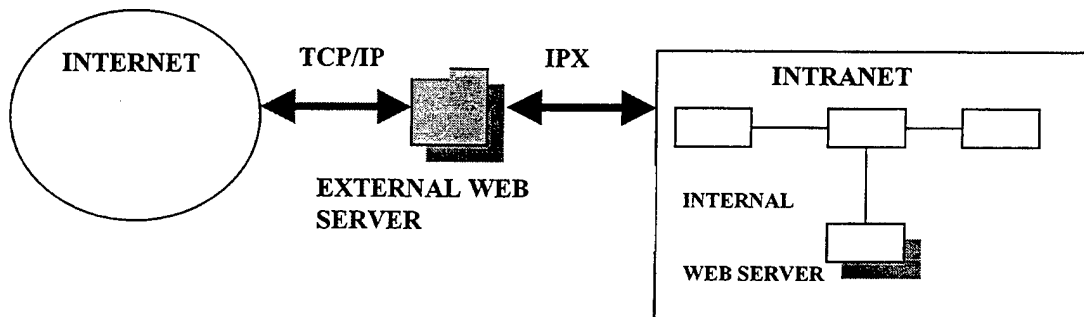


Figure 34. Protocol Isolation

## 2. Server Security

Both the operating system server and the web server must meet the following basic security requirements:

### *a. Physical security*

They must be physically secured. A separate room can be designated to accommodate both servers. Only authorized personnel should have access to this room.

### ***b. User Authentication***

Each user logging on to the network must be authenticated with a valid user name and password

### ***c. File and Directory Security***

The servers must be capable of assigning access permissions to files and folders in accordance with user rights and permissions.

### ***d. Configuration***

Both server configurations must be reviewed in order not to cause any security breaches. Servers come with default configurations may not be secure enough. For example the idea behind the security features of NT Server is optimistic. There is a user group called "Everyone" that has been given "Full Control" permission, which enables its members to gain enough permission to do anything to a file or folder. Every user logged onto the server is a member of this group. Therefore, when the server is set up the first time, this universal permission must be removed from the Everyone group.

## **3. User Awareness**

Every security issue depends on the users in an organization. Users are not only the ordinary employees who work in departments, but are also managers and network administrators. Security for an intranet is team work and one failure by one employee can cause major problems for the whole organization.

Every user must have a user name and password to access the Intranet. Users must be cautious about choosing sound passwords and keeping them secret. Security policies, guidelines and standards can be used to enforce this.

In training sessions, users must be given examples of events in which malicious attackers can gain full control of the whole network by grabbing only one user name and password. All the users must be convinced of the importance of individual responsibilities for the sake of the whole organization.

#### **4. Encryption and Secure Sockets Layer**

Encryption is a safe way of keeping private data secure on a hard disk. It can also be used while transferring data from one computer to another.

The secure sockets layer is a protocol that provides communication privacy over networks by using a combination of public key cryptography and bulk data encryption for data privacy. By using this protocol, clients and servers can communicate in a way that prevents eavesdropping, tampering, or message forgery. (Microsoft Press, 1996, pg.58)

#### **C. ADA SCHOOL INTRANET SECURITY**

This thesis will use NT Server 4.0 to build an intranet architecture. In order to benefit from the integrated services, Internet Information Server 4.0 will be used as the web server. This section will be about NT Server and IIS security features.

A Microsoft Windows NT-based network can be set up using either a domain model or a workgroup model. A domain is a logical grouping of computers that share common security and user account information. This account information is stored in the domain controller's master directory database. (Microsoft Press, 1998, pg. 7)

This is also the directory that determines the number of user accounts in a single or multiple domains. A single domain can accommodate up to 26,000 users. The number of users that NT Server supports is important for scalability. More detailed information is given in appendix J.

NT Server security depends on user accounts and user rights attached to those accounts. There are three basic user accounts:

- Accounts that you create
- Guest
- Administrator

The built-in guest account is used to give permission to the people who need to access computers for a short time. The built-in administrator account is used to manage the server and perform administrative tasks such as creating user accounts and managing security policies. It would be helpful to change the administrator account name to another name to make this account less vulnerable to attacks.

The ADA School intranet will have a single NT domain with different groups. The first step is to create groups of users who perform similar functions or are related to each other logically. Access rights and permissions then must be assigned to the groups.



Therefore, group accounts can be managed centrally rather than dealing with each user account individually. This will lessen the administrative work. Each major sub-unit at the ADA School will form a group such as a Headquarters Group that will hold the users working at the headquarters, an Education Group that will be for the users working at the directorate of education and so on.

In addition to this functional grouping there will be groups created according to user's ranks such as Officers Group, NCO Group and Enlisted Group.

The second step is to create user accounts for each user at the school and add each of them to the related groups. One person can be in more than one group. For instance, a Lieutenant, positioned at the Supporting Unit will have one user account added to two groups; Officers Group and Supporting Unit Group.

The third step is to decide which folder users can access. There are four share permissions:

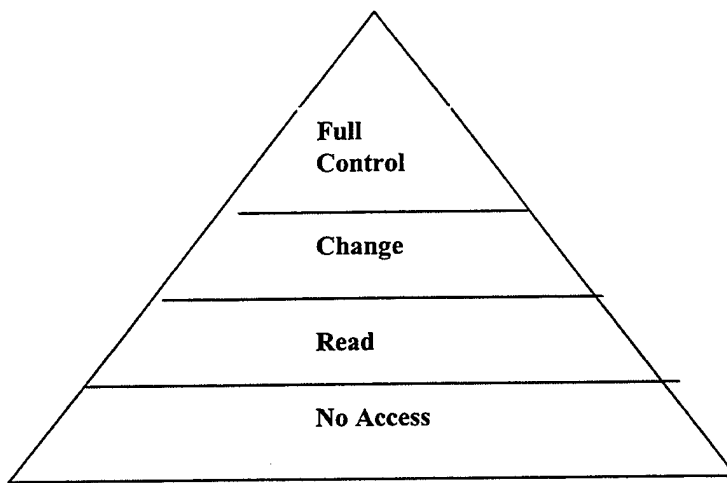


Figure 35. Share Permissions

The detail restrictions for share permissions and NT File System (NTFS) permissions are listed in Appendix K

After deciding on the shared folders, security must be tightened by using NTFS Permissions. The reason is that shared permissions do not apply to the users who log on to the server. If the user logs on to the server locally, then he or she has no share permission restrictions. However NTFS permissions apply to everyone.

Using NTFS file permissions can support finer granularity. For example, an administrator can set different permissions for each file in a folder. One user can read the

contents of a file and change it, another can only read the file and all other users can be prevented from accessing the file. (Microsoft Press, 1998, pg. 212)

There will be cases when two group permissions for one user will not match each other. In this case if the unmatched permissions are the share permissions then the least restrictive permission applies. However if the unmatched permissions are the NTFS permissions then the most restrictive permission applies.

Windows NT Server has another tool to track activities of users and the system called the auditing service. Windows NT can record a range of event types from a systemwide event, such as a user logging on, to an attempt by a particular user to read a specific file on an NTFS drive. Both successful and unsuccessful attempts to perform an action can be recorded.

An aspect of using products from the same vendor is that you do not need to specify different authentication means for your web server. Internet Information Server (IIS) 4.0 can use NT Server's master directory database and use the same user accounts for authentication. IIS 4.0 security and authentication features include Certificate Authentication, Certificate Wildcard Mapping and Domain Blocking.

With Certificate Authentication, an administrator can map clients to Windows NT Server user accounts using industry standard client certificates such as X. 509 digital certificates. A user can then be provided with single logon servers to network resources using client certificates. Certificate Wildcard Mapping is used to authenticate users without having access to the actual certificate. With this feature, an administrator can map users to Windows NT Server user accounts using third-party certificates such as those issued by VeriSign. Domain Blocking can be used to regulate access to content on the server selectively by domain. Domain Blocking is a reliable way of controlling access to content on a server by either granting or denying access to all users from a specified domain. (Microsoft Press, 1998, pg. 8).

This can be done in one of two ways. Everybody can get access right except those whose IP addresses are predefined in a list, or nobody can get access right except those whose IP addresses are predefined in a list.

See figure 36 for the illustration of domain blocking.

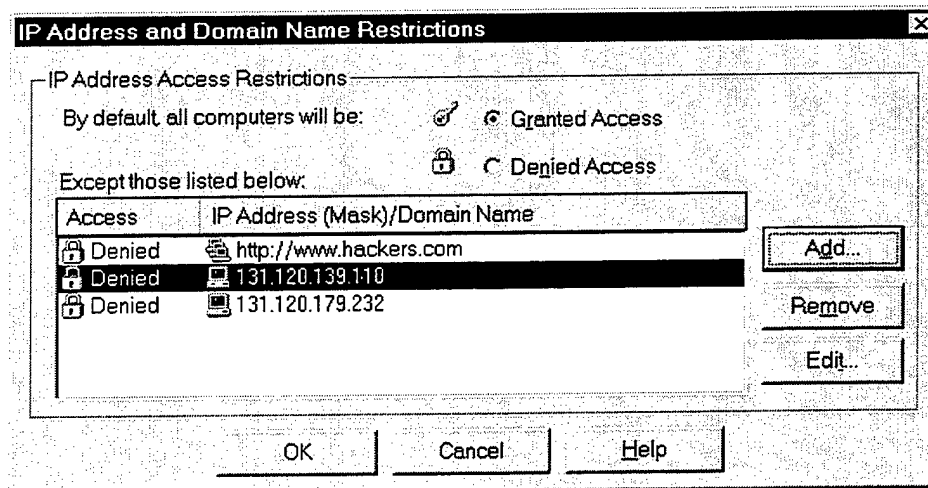


Figure 36. Domain Blocking

In addition to the NT Server and IIS security features, the author wrote an authentication code using Active Server Pages for access to the ADA school personnel database. Thus authorized-only users will be able to access the database. See Figure 24 in the previous chapter.

#### D. SUMMARY

Windows NT Server and IIS Server security features will be the basic means of providing security to the ADA School intranet. The security implementation on NT and IIS needs to be handled by an administrator. However, end users do not have to be technical inclined towards security. The only requirement is that they be cautious about keeping user names and passwords secret.

## **X. CONCLUSION**

### **A. SUMMARY**

The Intranet is a means of sharing knowledge and information in an organization. It empowers the users with necessary tools and data to carry out their duties in a better and more efficient way.

Simplicity and flexibility are the two features of a well-planned intranet. It is simple because users do not necessarily need very technical computer skills. All they need to know is how to use a browser, which is not difficult to learn.

It is flexible because content can be added at any time depending on the organization's specific requirements and user creativeness.

In order to provide this simplicity and flexibility, an intranet must be carefully designed. Software and hardware components should be updated parallel to the new enhancements in the industry.

Building an intranet from scratch does not only involve technical issues. It involves management of change and this means teamwork. The whole organization should be involved in the design and implementation process. Once the users are involved in and got their hands in the publishing process, they will gain confidence and own the intranet.

This thesis has designed and implemented an intranet for the ADA School. Hardware and software are the two main components of this intranet.

This study has focused on the software component. Since an intranet does not need any additional hardware if a local area network already exists and it is assumed that the ADA School has a LAN.

The basic software sub-components that are and will be used at the ADA School intranet are:

- Windows NT 4.0 as the network operating system.
- Internet Information Server 4.0 as the web server.
- Internet Explorer and Netscape as the web browsers
- SQL Server 7.0 and Access 97 as Database management systems ( The initial ADA school personnel database is designed by Access 97 and will be upgraded to SQL Server 7.0)

- Active Server Pages as the middleware for database connectivity and creating dynamic web pages.

The personnel database is the main application on the ADA School intranet and users can manipulate data in the database by simply using their web browsers.

## **B. FUTURE RESEARCH**

The ADA School with its three-year-old history will be a pioneer among the other combat arm schools in Turkey. This prototype will meet the minimum requirements of the school. However, once the personnel get used to it and the school accepts the usage of an intranet as an organizational culture, many new applications will be added such as a logistics database and an on-line course for personnel.

The ADA School intranet will also be a step to leverage the readiness of the school to the upcoming large-scale TLFC projects. By the time those computer related projects are deployed, the ADA School will have a ready culture and the personnel to succeed.

The final goal is to establish connectivity with the other combat arm schools and brigade level units and thus create a nation-wide intranet.

## APPENDIX A. THE INTERNET TIMELINE<sup>4</sup>

**1957**

USSR launches Sputnik, first artificial earth satellite. In response, US forms the Advanced Research Projects Agency (ARPA) within the Department of Defense (DoD) to establish US lead in science and technology applicable to the military.

**1961**

Leonard Kleinrock, from MIT, publishes the first paper on packet-switching theory

**1962**

Paul Baran from RAND Corporation was commissioned by the U.S Air Force to study how the U.S authorities could communicate after a nuclear attack.

**1964**

Paul Baran proposes a packet switched network, the basic scheme of the Internet that is still in use.

**1965**

ARPA sponsored a study on a "cooperative network on time sharing computers".

**1966**

Lawrence G. Roberts, from MIT publishes the first ARPANET plan "Towards a Cooperative Network of Time-Shared Computers"

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<sup>4</sup> Used with permission, Hobbes' Internet Timeline, copyright, 1999. The online version is at <http://www.isoc.org/zakon/Internet/History/HIT.html>

**1968**

PS – network is presented to the Advanced Research Projects Agency. Request for proposals are sent out. University of California Los Angeles (UCLA) is awarded Network Measurement Center contract. Bolt Beranek and Newman, Inc. (BBN) is awarded Packet Switch contract to build Interface Message Processors (IMPs).

**1969**

DoD commissions ARPANET for research into networking. Four nodes are stood up as BBN builds each IMPs (Honeywell DDP-516 mini computer with 12K of memory); AT&T provides 50kbps lines. The nodes are UCLA, Stanford Research Institute (SRI), University of California Santa Barbara (UCSB), and University of Utah.

Steve Crocker publishes first Request for Comment (RFC).

**1970**

ARPANET hosts start using Network Control Protocol (NCP) which is the first host-to-host protocol. The first cross-country link is installed by AT&T between UCLA and BBN at 56 KBPS. Another line is added between MIT and Utah.

**1971**

The number of nodes reaches 15 with 23 hosts: UCLA, SRI, UCSB, Univ. of Utah, BBN, MIT, RAND, SDC, Harvard, Lincoln Lab, Stanford, UIUC, CWRU, CMU and NASA/Ames.

Ray Tomlinson (BBN) invents email program to send messages across a distributed network.

**1972**

Ray Tomlinson modifies email program for ARPANET where it becomes a quick hit. The @ sign is chosen from the punctuation keys on Tomlinson's Model 33 Teletype for its "at" meaning.

International Conference on Computer Communications (ICCC) at the Washington D.C. Hilton with demonstration of ARPANET between 40 machines

and the Terminal Interface Processor (TIP) organized by Bob Kahn. First computer-to-computer chat takes place during ICCC as psychotic PARRY (at Stanford) discusses its problems with the Doctor (at BBN).

## 1973

University of London (England) and Royal Radar Establishment (Norway) are connected to the ARPANET as the first international connections.

Bob Metcalfe's Harvard Ph.D. thesis outlines idea for Ethernet. The concept is tested on Xerox PARC's Alto computers, and the first Ethernet network is called the Alto Aloha System.

Network Voice Protocol (NVP), is specified (RFC 741) and implemented, enabling conference calls over ARPANET. The number of ARPANET users reaches 2000 with 75% email traffic.

## 1974

Vint Cerf and Bob Kahn publish " A Protocol for Packet Network Interconnection " which specified in detail the design of a Transmission Control Program (TCP).

## 1975

John Vittal develops MSG, the first all-inclusive email program providing replying, forwarding, and filing capabilities.

Satellite links cross two oceans(to Hawaii and UK) as the first TCP tests are run by Stanford, BBN, and UCL.

Operational management of the Internet is transferred to DCA, which is now DISA.

## 1980

ARPANET grinds to halt on 27 October because of an accidentally propagated status- message virus.



**1981**

BITNET (Because It is Time Network) is established providing electronic mail and listserv servers to distribute information, as well as file transfers.

A collaboration of computer scientists and Univ. of Delaware, Purdue Univ. Univ. of Wisconsin, RAND Corporation and BBN build CSNET (Computer Science Network) through seed money granted by NSF to provide networking services (especially email) to university scientists with no access to ARPANET.

**1982**

Norway leaves BITNET to become an Internet connection via TCP/IP over SATNET; UCL follows suit.

DCA and ARPA establish the Transmission Control Protocol and Internet Protocol, as the protocol suite, commonly known as TCP/IP, for ARPANET.

**1983**

Name server is developed at Univ. of Wisconsin, no longer requiring users to know the exact path to other system.

ARPANET split into ARPANET and MILNET; the latter became integrated with the Defense Data Network created the previous year. 68 of the 113 existing nodes went to MILNET.

Desktop workstations come into being, many with Berkley UNIX (4.2 BSD) which includes IP networking software.

Internet Activities Board ( IAB) is established replacing ICCB.

**1984**

Domain Name System is introduced. Number of hosts reaches 1000.

**1985**

Symbolics.com is assigned on 15 March to become the first registered domain.

**1986**

NSFNET is created ( backbone for US with a speed of 56KBPS).

Internet Engineering Task Force (IETF) and Internet Research Task Force ( IRTF) comes into existence under the IAB.

## 1987

First TCP/IP Interoperability Conference is held (later it is renamed as INTEROP).

Number of hosts reaches 10,000.

## 1988

First nation wide Internet worm created by Morris, affects nearly 6000 of the 60000 hosts on the Internet.

CERT (Computer Emergency Response Team) is formed by DARPA in response to the needs exhibited during the Morris worm incident. Internet Assigned Authority Number (IANA) is established with Jon Postel as its Director. Postel was also the RFC Editor and US Domain registrar for many years. Jarkko Oikarinen develops Internet Relay Chat (IRC).

DoD chooses OSI (Open System Interconnection) and sees use of TCP/IP as an interim.

## 1989

Number of hosts breaks 100,000.

Cuckoo's Egg by Clifford Stoll tells the real-life tale of a German cracker group who infiltrated numerous US facilities.

## 1990

ARPANET ceases to exist.

Archie, an archiver for ftp sites, is released by Peter Deutsch, Alan Emtage, and Bill Heelan, at McGill University in Montreal.

The World comes on-line (world.std.com), becoming the first commercial provider of Internet dial-up access.

ISO Development Environment ( ISODE) is developed to provide an approach for OSI migration for the DoD. ISODE software allows OSI application to operate over TCP/IP.

## 1991

Wide Area Information Server ( WAIS), that indexes the full text of files in a Database and allows searches of the files, is invented by Brewster Kahle, and is released by Thinking Machines Corporation.

Gopher, the first friendly interface to the Internet, is developed at the University of Minnesota.

World-Wide-Web ( WWW) is invented by Tim Berners-Lee and released by CERN.

PGP ( Pretty Good Privacy) is released by Philip Zimmerman.

## 1992

Internet Society ( ISOC) is chartered. IAB is reconstituted as the Internet Architecture Board and becomes part of the Internet Society. Number of hosts breaks 1,000,000.

Veronica, a searchable index of gopher menus, is released by Univ. of Nevada.

## 1993

InterNIC is created by NSF to provide specific Internet services.

Mosaic, the graphical browser used to surf the Internet, is developed by Marc Andressen and his team.

## 1994

Communities begin to be wired up directly to the Internet.

First Virtual, the first cyberbank, opens up for business.

## 1995

NSFNET reverts back to a research network leaving the main US backbone traffic being routed through interconnected network providers.

Sun launches JAVA on May 23. Traditional online dial-up access systems (Compuserve, America Online, Prodigy) begin to provide Internet access.

A number of Net related companies go public, with Netscape leading the pack with the 3<sup>rd</sup> largest ever NASDAQ IPO share value.

Registration of domain names is no longer free. A \$50 annual fee has been imposed, which until now was subsidized by NSF.

## 1996

Internet phones catch the attention of US telecommunication companies who ask the US Congress to ban the technology.

MCI upgrades Internet backbone adding approximately 13,000 ports, bringing the effective speed from 155 MBPS to 622 MBPS.

The WWW browser war, fought primarily between Netscape and Microsoft, has rushed in a new age in software development, whereby new releases are made quarterly.

## 1997

The American Registry for Internet Numbers (ARIN) is established to handle administration and registration of IP numbers to the geographical areas currently handled by Network Solutions (InterNIC), starting March 1998.

Early in the morning of 17 July, human error at Network Solutions causes the DNS table for .com and .net domains to become corrupted, making millions of systems unreachable.

## 1998

Network Solutions registers its 2 millionth domain on 4 May.

E-commerce, E-Auctions, and Portals are the technologies of the year.

## 1999

Melissa virus storms through the Net in late March.

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## **APPENDIX B. FNC RESOLUTION**

The Federal Networking Council (FNC) agrees that the following language reflects the definition of the term "Internet". "Internet" refers to the global information system that:

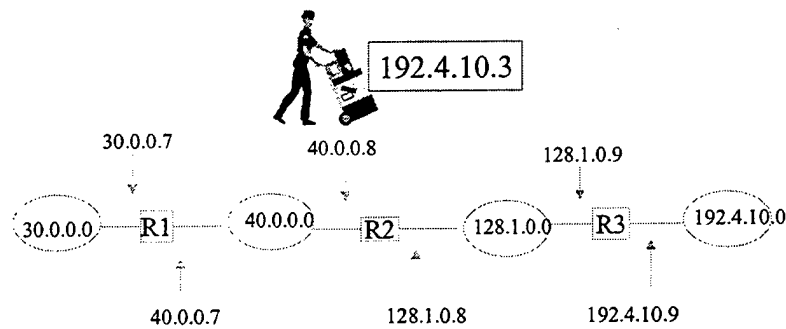
- (i) is logically linked together by a globally unique address space based on the Internet Protocol (IP) or its subsequent extensions/ follow-ons ;
- (ii) is able to support communications using the Transmission Control Protocol / Internet Protocol (TCP/IP) suite or its subsequent extensions / follow-ons, and / or other IP- compatible protocols; and
- (iii) provides, uses or makes accessible, either publicly or privately, high level services layered on the communications and related infrastructure described herein.

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## APPENDIX C. HOW DO ROUTERS WORK?

Routers are computers and that have routing tables used to track information about other routers and networks in the neighborhood. Whenever an IP datagram comes to a router, it simply extracts the destination address from the incoming IP Header and compares it to its table. If the destination address is in one of the networks to which the router is connected, it directly sends the datagram to that network. If not, it delivers the IP datagram to the most appropriate router that can send the message to its final destination.

Figure C-1 is an illustration of four networks connected by three routers. The IP Addresses in the ovals are the network addresses. Each router has two IP addresses assigned for its interfaces. The below table belongs to the center router( R2).



Destination	Mask	Next Hop
30.0.0.0	255.0.0.0	40.0.0.7
40.0.0.0	255.0.0.0	Deliver direct
128.1.0.0	255.255.0.0	Deliver direct
192.4.10.0	255.255.255.0	128.1.0.9

\* This table belongs to R2

Figure C-1. A Router Working Mechanism



In this figure an IP datagram comes to Router 2 (R2), with a destination IP address, 194.4.10.3. Router 2, extracts this address from the IP datagram and compares it to its routing table.

The table shows that Router 3 is the most appropriate router to send this datagram, so it routes the message to Router 3.

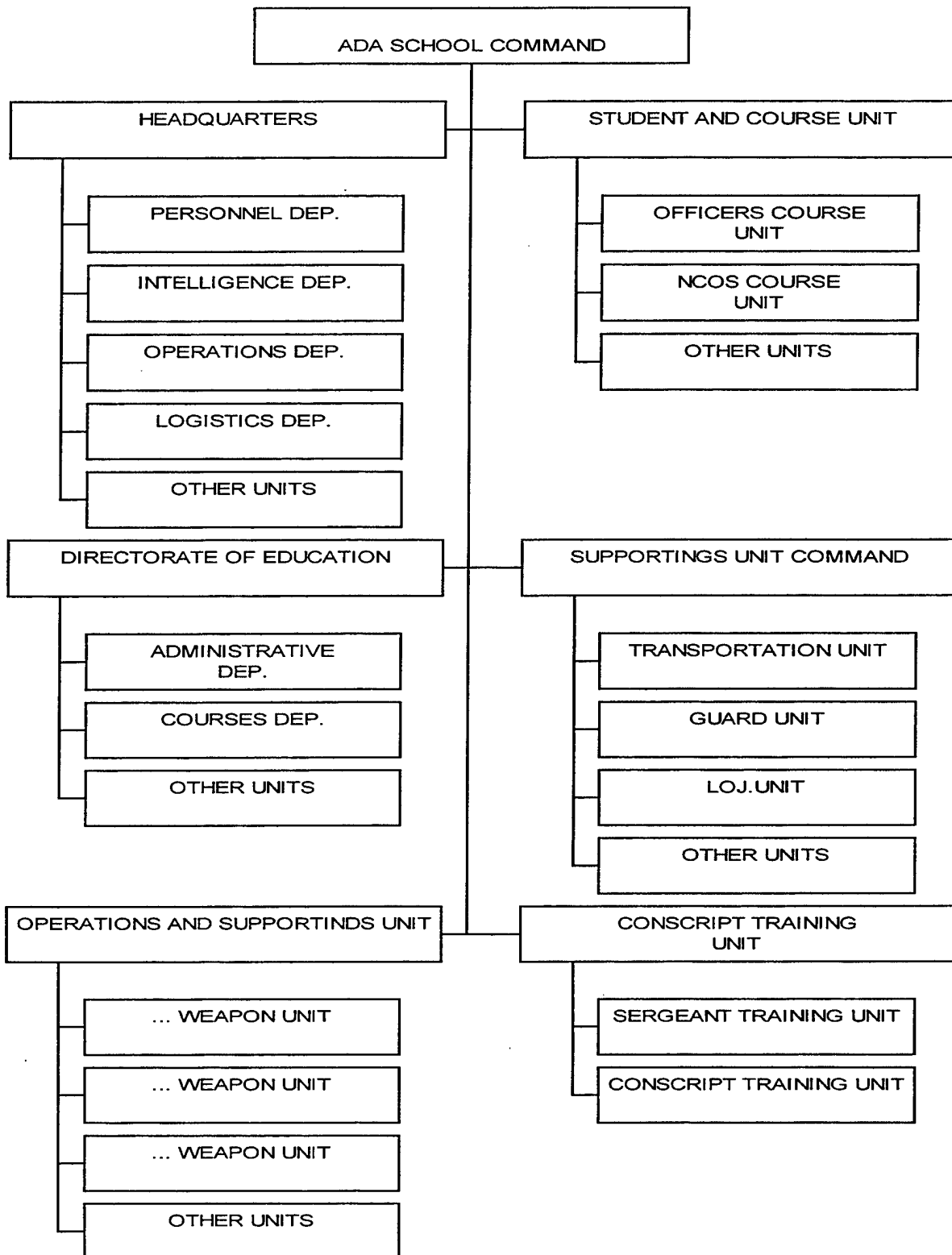
If this address were in range of one of the directly connected networks (40.0.0.0 and 128.1.0.0), Router 2 would send the datagram directly to one of those networks without any further routing.

## **APPENDIX D.      PLUG-INS. (Hills, 1997, pg. 15)**

- Remote-control software that allows you to control another PC over the Internet. Great tool for Help Desks.
- Collaborative software that allows you to review documents and watch editing on another user's screen. Good for collaboration among geographically dispersed workgroups and team.
- Engineering-drawing viewers for viewing computer-aided designs using your browser. Great for engineers and designers.
- Chemical-structures viewer for viewing 2D and 3D structures within a Web page. Great for chemists and other scientists.
- Viewers of allow you to view, copy and print documents created in Acrobat, Word, Word Perfect, Excel, Power Point and other software.
- Data entry forms with validation checking in the client browser.
- Installation plug-in that allows software distribution and installation from a Web page in a single step. Great for electronic software distribution throughout the organization.
- News service that downloads news to the viewer's computer screen. Great for internal and external news delivery throughout the organization.
- Application development tools, with drag-and-drop features, Visual Basic scripting, and more. Ease the job of applications developers.
- Speech synthesis to convert text to speech or singing. Great for training applications.
- Viewer for delivering existing computer-based training (CBT) courses using a browser. Leverage your investment in existing CBT.

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## APPENDIX E. ORGANIZATION CHART



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## APPENDIX F. PAPER COST SAVINGS

Currently, each company/battery level unit has to prepare a daily and weekly training schedules for itself. Each battalion level unit has to prepare a quarterly training schedule. A daily training schedule is about two or three pages, while a weekly one is about 15 pages and requires three copies. As seen in table 1, the total number of paper work for only training schedules for one battery is about 3500 per year. Having the fact that there are at least 20 units at ADA school who have to prepare those training schedules, the total number of paper goes up to 70 000.

Other than that, the paper work for administrative staff and formal correspondence requires about 500 pages per week, which makes about 25000 pages per year. Again having the fact that there are at least 20 units at that same situation, the total number of paper work reaches about 500 000 per year.

Some of the activities and reports that consume paper in a battery are :

	Daily (Pages)	Weekly (Pages)	Monthly (Pages)	Quarterly (Pages)	TOTAL (Pages)
Training schedules and programs	3	45	-	-	3435
Personal Count Report	1	1	1	1	423
ADA Response Report	-	-	60	-	720
Enlisted Departure	-	-	-	10	40
Enlisted Vacation	-	-	30	-	360
Security Report	-	-	10	-	120
Items Count Report	-	-	-	50	200
TOTAL					5298

Table F-1. Battery Paper Consumption

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**APPENDIX G. METHODS FOR DEALING WITH RESISTANCE TO CHANGE** (Kotter and Schlesinger,1979)

<b>APPROACH</b>	<b>COMMONLY USED IN SITUATIONS</b>	<b>ADVANTAGES</b>	<b>DRAWBACKS</b>
Education and Communication	Where there is a lack of information or inaccurate information and analysis.	Once persuaded, people will often help with the implementation of the change	Can be very time consuming if many people are involved
Participation And Involvement	Where the initiators do not have all the information they need to design the change and where others have considerable power to resist	People who participate will be committed to implementing change and any relevant information they have will be integrated into change plan	Can be very time consuming if participators design an inappropriate change
Facilitation And Support	Where people are resisting because of adjustment problems	No other approach works as well with adjustment problems	Can be time consuming, expensive and still fail
Negotiation And Agreement	Where someone or some group will clearly lose out in a change and where that group has considerable power to resist	Sometimes it is a relatively easy way to avoid major resistance	Can be too expensive in many cases if it alerts others to negotiate for compliance
Manipulation And Co-optation	Where other tactics will not work or are too expensive	It can be a relatively quick and inexpensive solution to resistance problems	Can lead to future problems if people feel manipulated
Explicit and Implicit Coercion	Where speed is essential and the change initiators possess considerable power	It is speedy and can overcome any kind of resistance	Can be risky if it leaves people mad at the initiators.



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## APPENDIX H. CURRENT WEB SERVERS AND FEATURES

WebServer Quick Compare			
Server	Version	Operating System	Price Range
AOLserver	2.3	Digital UNIX, HPUX, Linux, IRIX, Solaris	<i>Free (subscription-support)</i>
ArexxWebServer	2.0	Amiga	<i>free</i>
Alibaba	2.0	Windows 3.x, Windows NT, Windows 95	<i>\$99</i>
Allegro RomPager	2.20	NetBSD, Digital UNIX, BSDI, AIX, OS/2, Windows 3.x, SCO, HPUX, Macintosh, Embedded, Windows NT, Linux, MS-DOS, Windows 95, FreeBSD, IRIX, Solaris	
Amiga Web Server	1.0	Amiga	<i>Free</i>
Apache	1.3	NetBSD, Digital UNIX, BSDI, AIX, OS/2, SCO, HPUX, Windows NT, Linux, FreeBSD, IRIX, Solaris	<i>Free</i>
Baikonur Web App Server	1.9	Windows NT, Windows 95	<i>\$995</i>
Commerce Server/400	1.0C	AS/400	<i>\$4995 (suggested retail)</i>
EMWAC HTTP Server	0.991	Windows NT	<i>Free</i>
EmWeb Embedded Web Server	R3_03	Digital UNIX, BSDI, AIX, SCO, HPUX, Embedded, Windows NT, Linux, Windows 95, FreeBSD, IRIX, Solaris	
Enterprise Server	3.0	Novell NetWare	<i>\$1,295</i>
Enterprise Web Secure/VM	1.1	VM/CMS	<i>Model based pricing</i>
EnterpriseWeb/MVS	1.1b	MVS	<i>Model based pricing</i>
EnterpriseWeb/VM	1.1.4	VM/CMS	<i>Model based pricing</i>
GoAhead WebServer	2.0	Embedded, Lynx, Windows NT, Linux, Windows CE, QNX, Windows 95, Windows 98, Solaris	<i>Free, embedded web server</i>
HTTPd for OS/2	1.15	OS/2	<i>Free</i>
Hawkeye	1.3.3	Linux, FreeBSD, Solaris	<i>private lic. free, non-p.&gt;\$250</i>
Internet Information Server	4.0	Windows NT	<i>Free with NT 4.0 option pack</i>
Java Server	1.1	OS/2, HPUX, Windows NT, Linux, Windows 95, IRIX, Solaris	<i>\$295</i>
Lotus Domino Go Webserver	4.6.1	Digital UNIX, AIX, OS/2, HPUX, Windows NT, Windows 95, IRIX, Solaris	<i>\$495; free demo</i>
NCSA HTTPd	1.5.2a	NetBSD, Digital UNIX, BSDI, AIX, SCO, HPUX, FreeBSD, IRIX, Solaris	<i>Free</i>
Netscape Enterprise Server	3.5.1	Digital UNIX, AIX, HPUX, Windows NT, IRIX	<i>\$1,295</i>
Oracle Web Application Server	3.01	HPUX, Windows NT, Windows 95, Solaris	<i>N/A</i>
RapidControl for Web(tm)	2.31	NetBSD, Digital UNIX, BSDI, Windows 3.x, SCO, HPUX, Windows NT, Linux, MS-DOS, Windows 95, FreeBSD, IRIX, Solaris	<i>N/A</i>

Roxen Challenger	1.3	NetBSD, Digital UNIX, AIX, SCO, HPUX, Windows NT, Linux, Windows 95, FreeBSD, IRIX, Solaris	<i>Free</i>
Roxen Challenger	1.2b	NetBSD, Digital UNIX, BSDI, AIX, SCO, HPUX, Linux, FreeBSD, IRIX, Solaris	<i>GPL, with support \$795</i>
Roxen Platform	1.0	NetBSD, Digital UNIX, AIX, SCO, HPUX, Linux, FreeBSD, IRIX, Solaris	
Spinnaker	3.0	Windows NT, Windows 95	<i>\$249</i>
Spyglass MicroServer	2.0	Embedded, Windows NT, Linux, Solaris	
VM Webgateway	2.2	VM/CMS	<i>Based on model groups or MIPS.</i>
Viking	0.9.33	Windows NT, Windows 95	<i>\$100 Early Releases</i>
WebSTAR	3.0.2	Macintosh	<i>\$499</i>
WebSite Professional	2.2	Windows NT, Windows 95	<i>\$799</i>
WebTen	2.1	Macintosh	<i>\$495</i>
Xitami	2.2b	NetBSD, Digital UNIX, BSDI, AIX, OS/2, Windows 3.x, SCO, HPUX, Windows NT, Linux, MS-DOS, VMS, Windows 95, FreeBSD, IRIX, Solaris	<i>Free</i>
Zeus Web Application Server	3	Digital UNIX, AIX, HPUX, Windows NT, Linux, IRIX, Solaris	<i>\$1,699 US; 999 UKP</i>
Iserver	1.5.0	NetBSD, Digital UNIX, AIX, OS/2, Java VM, SCO, HPUX, Novell NetWare, Macintosh, Windows NT, Linux, Windows CE, Windows 95, FreeBSD, Windows 98, IRIX, Solaris	<i>\$50 US</i>
VqServer	1.03	Be OS, Windows NT, Linux, Windows 95, Solaris	<i>Free!</i>

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## APPENDIX I. DATABASE SYSTEM

### A. DEFINITION

A Database system is a way of gathering to specific pieces or lists of information and it provides a way to store and maintain that information. The two components in a Database system are: the Database Management System (DBMS), which is the program that organizes and maintains these lists of information, and the database application, a program that lets us retrieves, views and updates the information stored by the DBMS.(Salemi, 1995, pg 2)

Prior to database technology, file-processing systems, in which the business information systems stored groups of records in separate files, were the prevalent applications. Due to the limitations listed below, file-processing systems couldn't meet the business requirements anymore and turned the stage over database technologies: (Kroenke, 1998, pg. 11)

- Data are separated and isolated.
- Data are often duplicated.
- Application programs are dependent on file formats.
- Files are often incompatible with one another.
- It is difficult to represent data in the users' perspectives.

Figure I-1 shows the basic database hierarchy and database components.

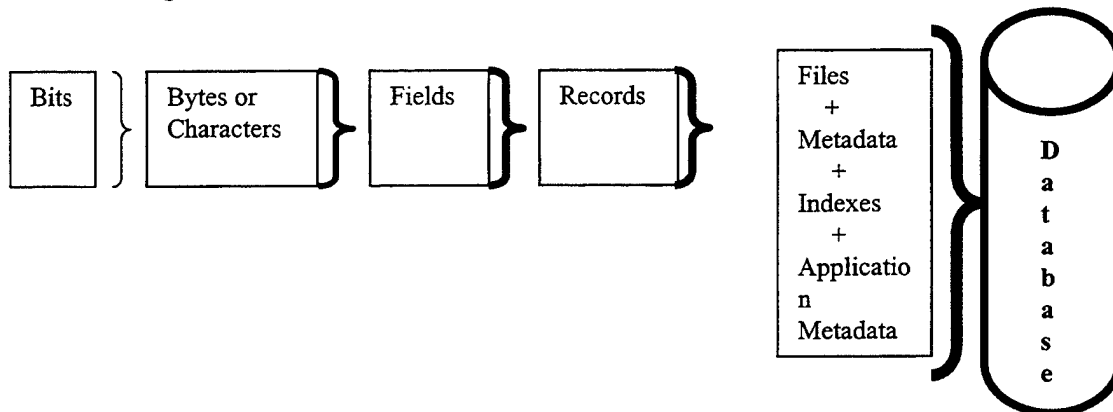


Figure I-1. Database Components ."From Kroenke, 1998, pg.15"

Some basic definitions of the terms that are frequently used in and part of a database are as follows:

A bit is the smallest amount of data that a computer can process which is either 1 or 0 in binary numbering system (base 2). A byte is a collection of 8 bits and each character has one byte of information. In other words the letter "a" can be represented in 8 bits.

A field is the smallest logical unit of data like "Employee ID", "Last Name", "First Name" or "Title". See Figure I-2.

A record is a collection of related fields such as an "Employee record" or "Student record". See Figure I-2.

Field 1   Field 2   Field 3   Field 4   .....

Employee ID	Last Name	First Name	Title	Title Of Courtesy	Birth Date	Hire Date	Address	City	
1	Davolio	Nancy	Sales Representative	Ms.	00-Dec-40	01-May-92	507 - 20th Ave. E.	Seattle	V
2	Falleur	Andrew	Vice President, Sales	Dr.	19-Feb-52	14-Aug-92	908 W. Capital Way	Tacoma	V
3	Levell	Janet	Sales Representative	Ms.	30-Aug-63	01-Apr-92	722 Moss Bay Blvd.	Kirkland	V
4	Peacock	Margaret	Sales Representative	Mrs.	19-Sep-37	03-May-93	4110 Old Redmond Rd.	Redmond	V
5	Hirshman	Steven	Sales Manager	Mr.	11-Mar-55	17-Oct-93	14 Garrett Hill	London	
6	Suyama	Michael	Sales Representative	Mr.	02-Jul-63	17-Oct-93	Coventry House	London	
7	King	Robert	Sales Representative	Mr.	23-May-60	02-Jan-91	Edgeham Hollow	London	
8	Callahan	Laura	Inside Sales Coordinator	Ms.	09-Jan-58	05-Mar-94	4726 11th Ave. N.E.	Seattle	V
9	Dodsworth	Anne	Sales Representative	Ms.	27-Jan-66	15-Nov-94	7 Houndtooth Rd.	London	

\* (AutoNumber)

Record 3

Figure I-2. Database Records

Kroenke (1998) describes metadata, indices and application metadata as important components of a modern database.

Metadata is the description of the structure of a database, such as table names, number of columns in each table, primary keys, data type of a column and length of a column.

Indices are usually used to access data quickly and sort it. Application metadata is the data about the user forms, reports, queries, and other application components.

## B. DATABASE MANAGEMENT SYSTEMS

A Database management system (DBMS), which is also called a model, is a kind of service to manipulate data in a database. It is a special software to create and maintain a database, and enable individual business application to extract the data they need without having to create their own files or data definitions (Laudon, 1997, pg. 202).

Salemi(1995) groups the available DBMSs into four categories :

1. File management system
2. Hierarchical database system
3. Network database system
4. Relational database system

File management system is the earliest database model that stores data sequentially on disk. So, in order to find a particular data one has to search all the data till he reaches the right one, which of course is not practical at all as seen in Figure I-3

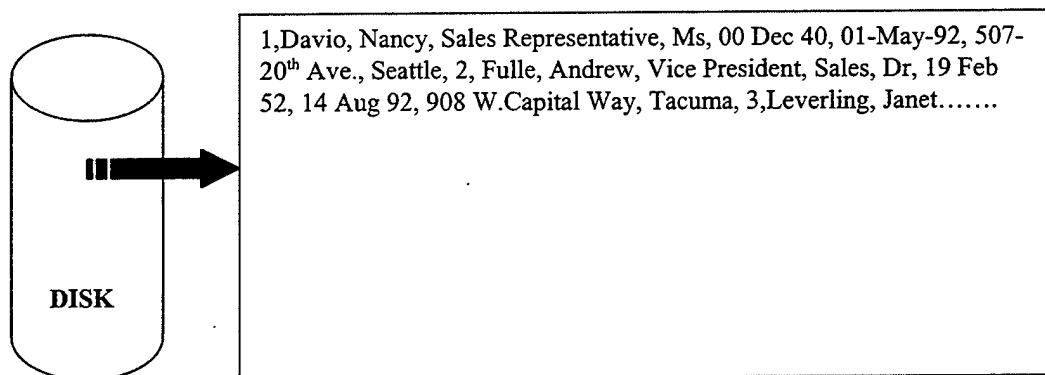


Figure I-3. File Management System

Hierarchical database model lessens this burden, by organizing data in a tree structure. See Figure I-4.

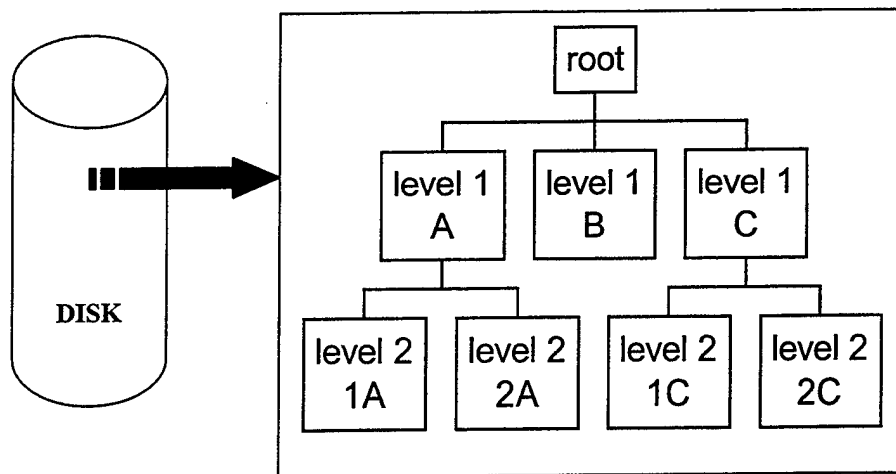


Figure I-4. Hierarchical Database

With this structure it is easier to reach a particular data than it is before. Especially using indices helps a lot to increase the access speed to data. However the rigid structure has lack of flexibility and is unable to implement many-to-many relationships. The relation between the levels is called parent-child relationship and once you are done with the design, it is difficult to make slight changes to the database. You must construct the whole parent-child relationships from the beginning in case of a modification.

The many-to-many relationship implementation problem is solved with a new logical concept of database: network database systems.

Although, the concept model originated in the 1960s, first written specifications were released in 1971 by the Conference on Data System Languages ( CODASYL), and are still sometimes referred to as CODASYL databases. ( Salemi, 1995, pg11).

In this structure one level can have cross-links between other levels as in figure I-5.

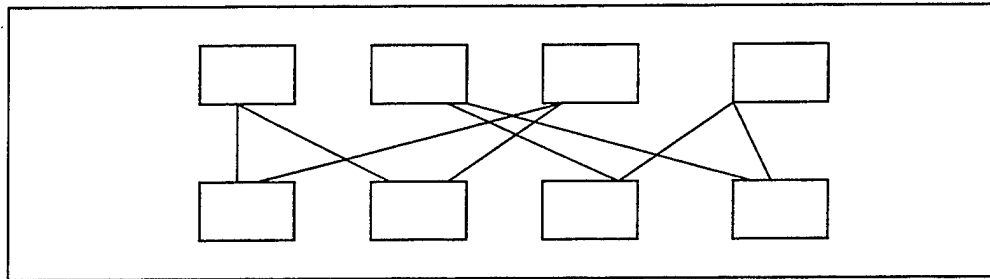


Figure I-5. Network Database

Thus, the many-to-many relationships between different sets of data is possible via pointers, special markers which maps to the real memory addresses on the disk.

Based on a paper published by Codd(1969), a relational database model abandons the concept of parent-child relationships between different data items. Instead, the data are organized in logical mathematical sets in a tabular structure. Each data field becomes a column in a table, and each record becomes a row in the table as seen in Figure I-6. (Salemi,1995,pg.14)

PERSON (Table1)		
ID_no	FirstName	LastName
10001	Muammer	Aygar
10002	Mehmet	Ergun
10003	Talha	Oktay

VEHICLE (Table 2)			
Serial_no	Model	Make	Owner_ID
20001	Mazda RX-7	1986	10001
20002	Hyundai	1990	10002
20003	Toyota	1993	10003

Figure I-6. Records In a Table



Each table has a modular structure, which makes any kind of modification easier. The ID number of the person relates tables in Figure I-6 to each other. The number of the related tables can be increased and as long as you have relations between tables it is not a big deal to track related data.

The relationship between the tables avoids data redundancy and duplication. Thus if you want to make any change to one of the tables that has a relation with an other table you have to consider both of the tables before making any change. Otherwise the DBMS doesn't let you make the change.

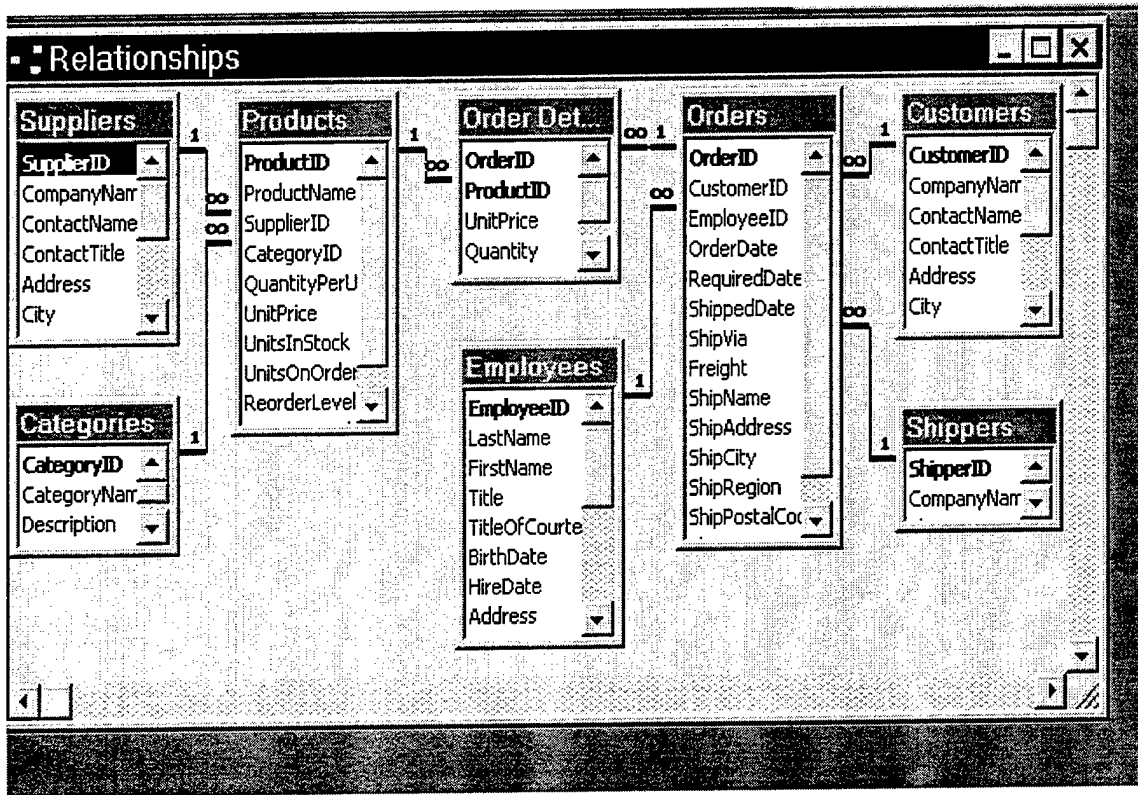


Figure I-7. Relational Database

As seen in Figure I-7, in order to add or delete an employee in table "Employees", you must make changes in table "Orders" to avoid redundancy and data duplication.

Perhaps the most important advantage of a relational database model over the previous database models is that you don't have to redesign the database from scratch if you need to make any modifications. To keep up with environment and organizational structure, you may be in need of frequent updates to your model.

The success of a relational database model mostly depends upon the accuracy of the table designs. To decide which columns to include in a table is the major decision and the process of arranging the columns by breaking the tables into more modular pieces is called normalization.

### **C. DBMS SYSTEM ARCHITECTURES**

Salemi (1995), breaks down the type of computer systems that databases run on, into four categories or platforms:

- Centralized platforms
- PC systems
- Client-Server platforms
- Distributed processing systems

#### **1. Centralized Platforms**

In a centralized platform, there is a powerful computer in a certain center. This computer is usually a mainframe and it runs all the programs on it that are necessary to carry out the requirements within the system.

End users connect to this powerful computer via terminals that are mostly dumb, with no or very little processing power as seen in Figure I-8.

The main advantage of this platform is the easiness in maintaining security with regard to other systems. Because all the data and the application programs are centralized, there is a less overhead in management. However the cost of this system is quite high and the maintenance of the mainframes may be toilsome.

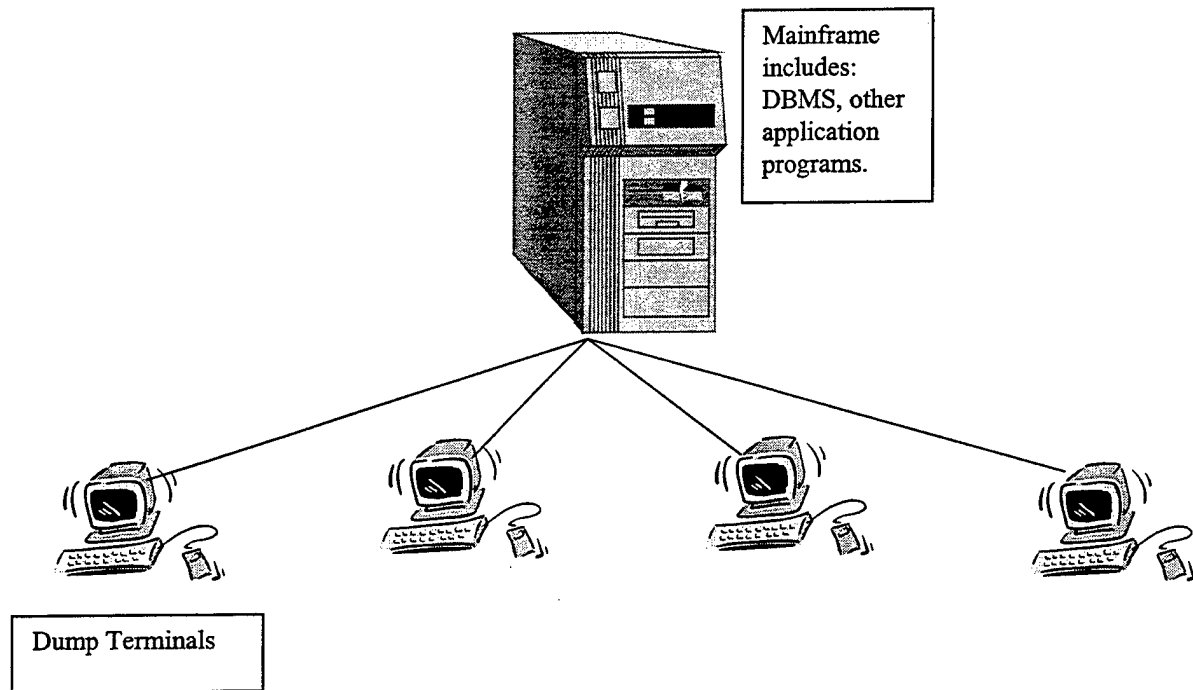


Figure I-8. Centralized Platform

## 2. PC Systems

Currently most of the stand-alone PCs have nearly the same processing power of the early mainframes. This power enables the manufacturers to produce DBMS that can run on PCs.

As long as there is a single user, these systems are both cost-effective and easy to learn. However they are not good at multi-user environments in which simultaneous transactions occur frequently.

On the other hand if you are using PCs in a network environment such as a LAN, it is still possible to run multi-user DBMS with some type of locking schemas.

### 3. Client-Server Databases

The drawbacks PC-based multi-user database systems were solved with development of client-server database systems.

In a way it benefits both of the previous centralized and PC-based systems, by running the database applications on PCs those act as clients and running all or part of the actual DBMS on the database servers.

The database application on the client PC, referred to as the front-end-system, handles all the screen and user input/output processing. The back-end system on the database server, handles data processing and disk access. For example, a user on the front-end creates a request (query) for data from the database server, and the front-end application sends the request across the network to the server. The database server performs the actual search and sends back only the data that answer the user's query. (Salemi, 1995, pg. 22)

Figure I-9 is a typical client-server database system.

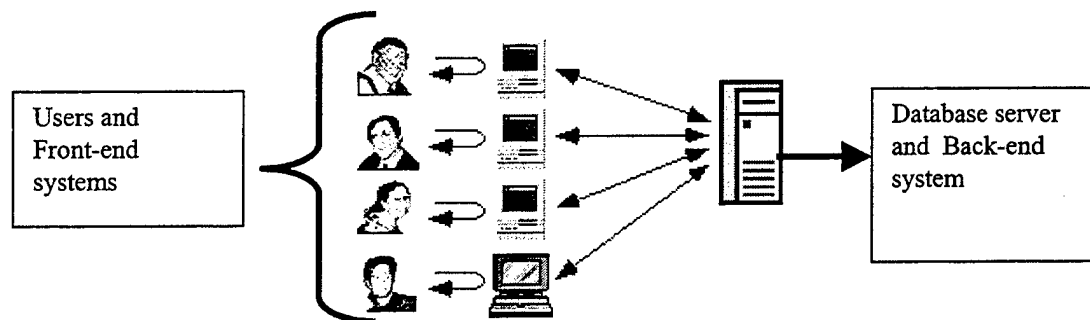


Figure I-9. Client-server Database System

Any computer can be a client or server, but because of cost considerations the client and the server are often a microcomputer. Sometimes the server is a mini or mainframe when considerable power is required from the server or, for political or organizational reasons, it is inappropriate to locate the database on a microcomputer. The clients and servers are generally connected together using a local area network (LAN).

The typical client-server architecture that is shown in figure 30 is a two-tier architecture where all the components of an application are divided among two software entities. This type of architecture works well in relatively homogeneous environments with fairly static business rules. For dispersed, heterogeneous environments with rapidly changing rules, there is another client-server architecture called three-tier client-server architecture. In this type, an additional middle tier functionality server is added to the architecture. (Gallaughier,1996)

The main advantage of client-server database system is that, since the bulk of the database processing is done on the back-end, the speed of the DBMS is not tied to the speed of the workstations and because the client is separated from the server, users are no longer limited to one type of system of platform. The workstations can be IBM-compatible PCs, Macintoshes, UNIX workstations, or a combination of these, and can run multiple operating systems. The main disadvantage of a client-server database system is the increased cost of administrative and support personnel who maintain the database server, especially, if the number of users is very large. (Salemi,1995,pg.35)

However, mainly due to the complexity, there is a concern about the client-server system failures. Especially the three-tier architecture applications require more planning and support. According to the Standish Group, 30% of the client-server projects fail.

#### **4. Distributed Processing Systems**

Think about a client-server database system in which there is more than one database server that runs the same database. Each of them is distributed over a network so that multiple users can access to the most available server. In order to maintain data integrity, all the servers are synchronized periodically and after the close of the business day all data goes to a large central mainframe. This is a simple distributed database system.

When compared to the other systems, distributed database systems are much more complicated. It is more difficult to maintain both administrative and technical issues. Especially maintaining data integrity really requires professional planning and administration.

On the other hand, it is more effective than the other systems.

## D. DATA MODELING

Data modeling is the process of creating a representation of the users' view of the data and is the most important task in development of effective database applications. If the data model incorrectly represents the users' view of data, the users will find the applications difficult to use, incomplete, and very frustrating. Therefore it is the basis for all subsequent work in the development of databases and their applications.(Kroenke,1998, pg47.)

There are currently two main data modeling tools being used :

- Entity- Relationship (E-R) model
- Semantic Object model

### 1. Entity-Relationship Model

This model includes four basic elements:

- Entities
- Attributes
- Identifiers
- Relationships

An entity is something that you can define and you want to track in a database like a person, a student, a vehicle or a father. Attributes are the properties of the entities like the age of a person, or the name of a student.

Identifiers are the attributes of an entity that identify those entities. If we were to identify a person, we would probably use the social security number or the name of that person.

In this model, entities are associated with each other in relationships. Suppose that we have a soldier and a gun as entities. The relationship between these two entities is that a soldier may have many guns but a gun can be owned by only one soldier at a time. The representation of this relationship in E-R model is as follows:

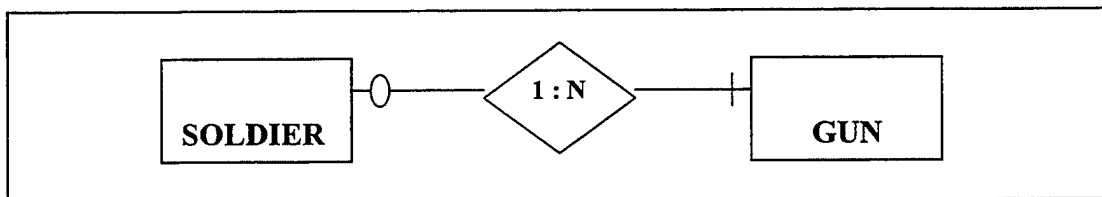


Figure I-10. Entity Relationship Model

“1 : N” represents the maximum cardinalities which means the maximum number of entities that can be involved in a relationship. The other possibilities of a maximum cardinality are “M:N”, many to many and “N:1”, many to one.

The has mark “|” on the “gun” side means the entity across the relationship line (in this case “soldier”) must exist in the relationship. The oval shape “0” on the “soldier” means that the entity across the relationship may or may not exist. Both of those signs show the minimum cardinalities, which means the minimum number of entities that can be involved. Of course, those cardinalities mostly depend on the programmer’s assumptions. You may assume that a soldier can not be imagined without a gun while another programmer may assume a soldier who is stationed in a hospital and doesn’t have any gun. So it is very important that all the assumptions related to the modeling must be clearly stated prior to the design of the database.

## **2. Semantic Object Model**

This model uses semantic objects instead of entities. A semantic object is a named collection of attributes that sufficiently describes a distinct identify.(Kroenke,1998, pg.72)

The word “sufficiently” is important, because an object must have enough attributes to be a semantic object. A semantic object has both attributes and identifiers like an entity. In addition to those it has attribute domains that are the descriptions of the attributes’ possible values.

The primary difference between an E-R model and a semantic object model is that Entities are the basic focus area in an E-R model, where semantic objects are, in the other model.

Figure I-11 is a simple representation of a semantic object called department :

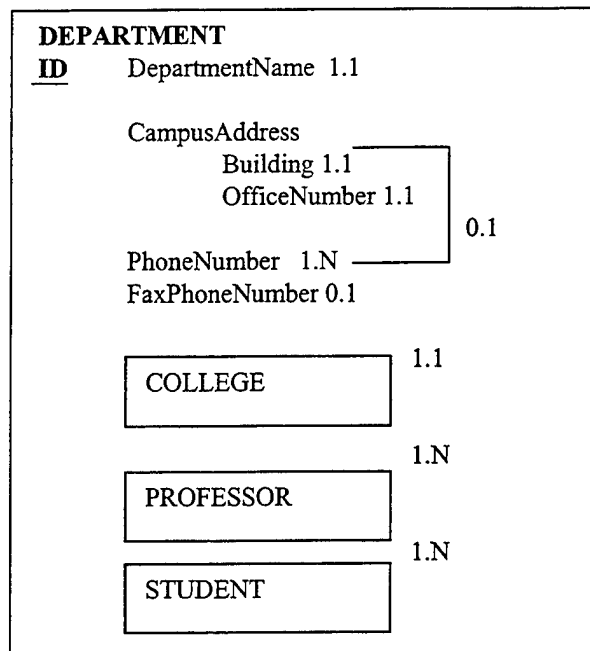


Figure I-11. Semantic Object Model. From "Kroenke, 1998, pg 73."

Being the cores of this model there are different kinds of objects to represent different kind of data. The basic object types are:

- Simple objects
- Composite objects
- Compound objects
- Hybrid objects
- Association objects
- Parent/Subtype objects
- Archetype/Version objects

This thesis will implement the prototype database application by using semantic object data modeling.



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## APPENDIX J. DATABASE CONNECTIVITY

### A. COMMON GATEWAY INTERFACE

Common Gateway Interface (CGI), is a web server scripting standard which enables the scripts to connect to the web servers. It is a set of standard around the communication between a web server and server-side applications. These standards provide the gateway through which data can pass between the web server and a CGI application. (Sam.net, 1998. Pg.526)

It is important to understand that CGI is neither a programming language nor a script. It is rather the mechanism to enable scripts operate within standards as seen in Figure J-1.

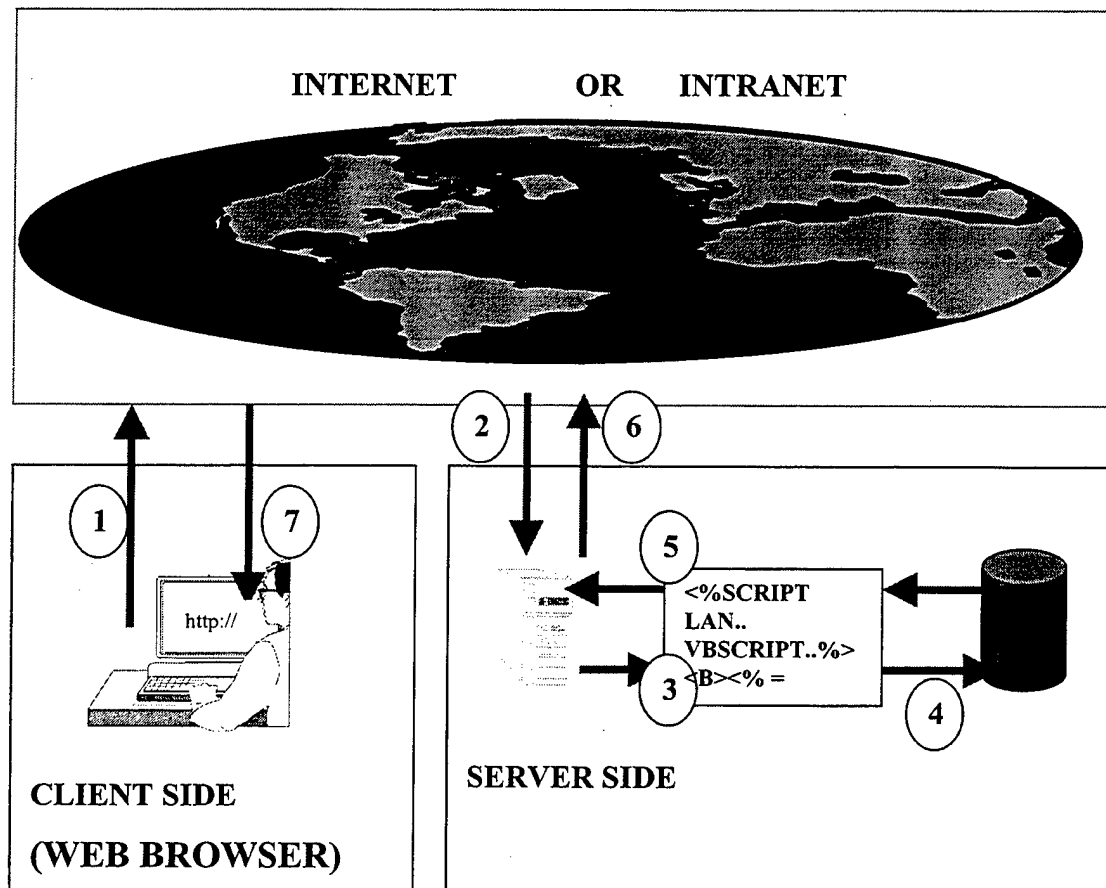


Figure J-1. CGI Mechanism

Now, let's figure out how this mechanism works by giving an example related to the Figure J-1.

Suppose that you want to buy a book from an on-line store and typed the URL "http://www.amazon.com" on the address location of your browser. Typing that web page address is actually a way of making a request. One of the main functions of a browser is to make requests on behalf of the users. The web server that runs at the company site is titled to serve our request, which is one of its main functions.

The first page that we see is the homepage of the company, which is usually default.html or index.html. This is the page where the companies offer their various services such as buying products, making a search or making a query via links. In our example, we will buy a book, so we click on the relevant link, which takes us to another page where we can choose the book we want. Before giving the order to buy, we need to give some personal information for a shipment and payment. The most common way to provide that information is using forms that usually have submit or reset buttons at the bottom. By the time we click on the submit button, what we are doing is, specifying a script to be executed via our browser. This is another request made by our browser and sent via the Internet to the web server of the company. The server running at the company site, itself, is unable to take that information and store it. So it calls one of the scripts that reside on the server to execute this process. The script communicates with a related user database and stores the information in that database and retrieves data if appropriate. Then, another script is called to return an output to the web server, which in our case is simply confirmation info. The web server sends this script output back to the browser and the browser parses and processes the script output.

The majority of dynamically created pages on the Web right now are created by CGI. It has severe shortcomings. The major one is that it adds an extra level to browser-server model of interaction and it is necessary to run a CGI program to create the dynamic page, which is sent back to the server. Also, many programming languages do not easily manipulate the code that CGI receives and transmits. The new generation consists of dynamic web pages that are built with a combination of languages and technologies. (Francis, 1998, pg13.)

Those most common languages and technologies that can be used to create dynamic web pages are:

1. Java
2. Scripting Languages
3. ActiveX Controls
4. Dynamic HTML
5. ColdFusion
6. Active Server Pages

## **B. DYNAMIC WEB TECHNOLOGIES**

### **1. Java**

Java is a stand-alone, cross-platform language for developing applications. Being the most popular programming language today, it is thoroughly object-oriented and differs from the traditional structural languages.

Its power comes from its being portable, which means it can work on any platform, whether Unix, Windows or any other operating systems. Thus it is a perfect choice for the Internet applications that mostly require platform-independent applications.

It has generated excitement because it makes it possible to program for Internet by creating applets, programs that can be embedded in a web page. The content of an applet is limited only by one's imagination. For example, an applet can be an animation with sound, an interactive game or a ticker tape with constantly updated stock prices. Applets can be just little decorations to liven up a web page, or they can be serious applications like word processors or spreadsheets. (Hamilton, 1998, pg.15)

### **2. Scripting Languages**

Scripts are some kind of foreign commands that add capabilities when embedded within the HTML code.

There is a variety of programming languages that can be used to write scripts. Perl, Shell, C, C++, JavaScript and VBScript are some of those. The last two are the main script languages that are used and created specifically for Internet applications.

Despite the similarities, Java and JavaScript are different languages. VBScript is a light version of Visual Basic language created by Microsoft.

When a browser views a page that has script in it, it sends that script to a script host, which is an application that can run a program in another language. A script engine

interprets the script here. Each scripting language needs its own interpreter. So, a Vbscript program must be sent to a VBScript interpreter, and a JavaScript program to a JavaScript interpreter. Internet Explorer 4 contains both interpreters while Netscape Navigator 4 only contains a JavaScript interpreter. (Francis, 1998, pg 44.).

The script that contains the script engine can either be on client-side or server-side. If a script is interpreted by a browser than it is called a client-side script. If it is interpreted by a web server then it is called server-side script.

Both script types have advantages and disadvantages. The main disadvantage of a client-side script is that it depends on the browser used. If you want to use VBScript with Netscape browser, you need to get some third party add-in program to do that. On the other hand if the network traffic is a concern and you don't want many trips between the client and server, client-side scripting lessens some of the burden.

The following is a simple script written by VBScript language.

```
<html>
<head>
<title>Writing the Current Date to a Document with ASP Script</title>
</head>
<body BGCOLOR="WHITE">
<p>This is your first script example. Today's date is <script
LANGUAGE="VBSCRIPT"
RUNAT="SERVER">
Response.Write(Date)
</script> . </p>
</body>
</html>
```

The outcome for this code is:

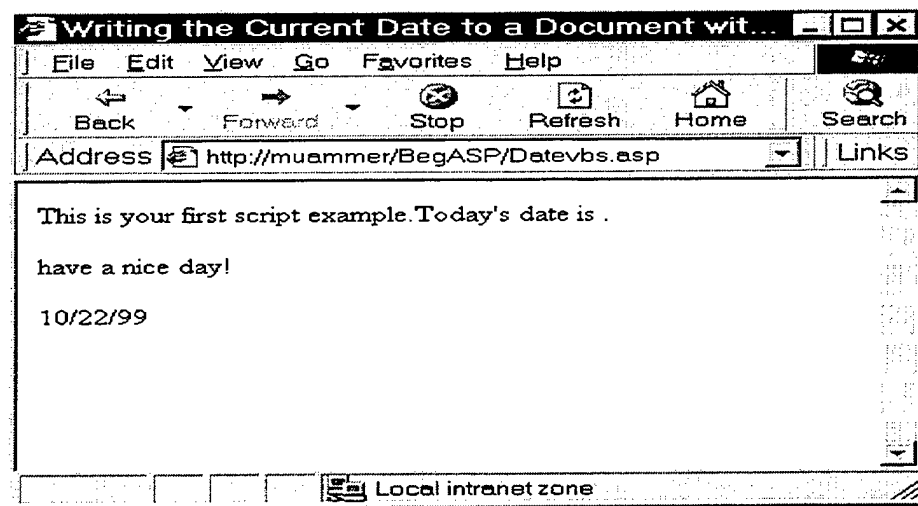


Figure J-2. VScript Sample

### 3. ActiveX controls

ActiveX controls are self-contained programs, known as components that are written in a language such as C++ or Visual Basic. When added to a web page, they provide a specific piece of functionality, such as bar charts and graphs, timers, client authentication, or database access. They are added to HTML pages via `<OBJECT>` tag, which is now part of the HTML standard. They can also be executed by the browser or server, when they are embedded in a web page. (Francis, 1998, pg.14)

These components are part of the main technology called Component Object Model (COM) created by Microsoft.

Microsoft sees that technology as a mean of competing against Java and its applets created by Sun Microsystems.

### 4. Dynamic HTML

Dynamic HTML is a collective term for a combination of new Hypertext Markup Language (HTML) tags and options, style sheets, and programming that will let you create Web pages more animated and more responsive to user interaction than previous versions of HTML. Much of dynamic HTML is specified in HTML 4.0. Simple examples

of dynamic HTML pages would include (1) having the color of a text heading change when a user passes a mouse over it or (2) allowing a user to "drag and drop" an image to another place on a Web page. Dynamic HTML can allow Web documents to look and act like desktop applications or multimedia productions. (<http://www.whatis.com>)

Dynamic HTML can be thought of as an extension scripting languages that offers some extra features such as the ability of animation and positioning graphics more precisely. However it is not a programming language.

The fifth and sixty technologies have been mentioned in chapter VII.

### **C. DATABASES WITH ASP**

There are three main terms that we will refer to in this section :

- Open Database Connectivity (ODBC)
- Object linking and embedding (OLE-DB)
- ActiveX Data Objects (ADO)

#### **1. ODBC**

ODBC was designed to allow a common set of routines to be used to access databases. In other words it is a standard application program interface to access databases. By using ODBC a programmer can easily connect to a database and manipulate the data, without having any trouble in implementing further details. See Figure J-3.

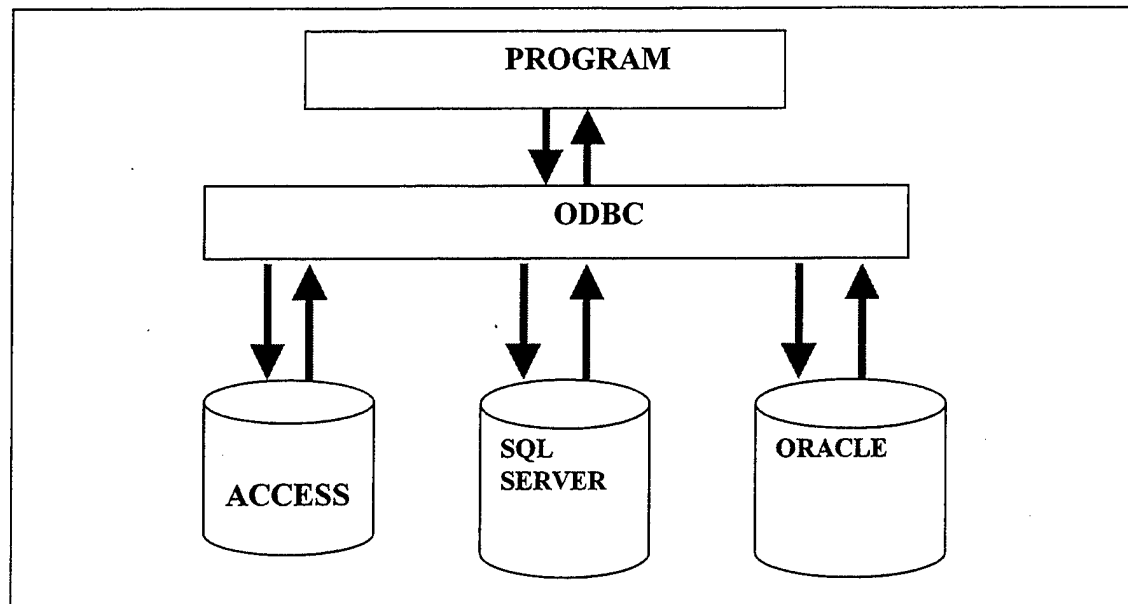


Figure J-3. From "Francis1998, pg.406."

Having provided the proper drivers for each of them, you can reach any files in different databases such as Access, SQL or Oracle..

ODBC was created by the SQL Access Group and first released in September, 1992. Although Microsoft Windows was the first to provide an ODBC product, versions now exist for UNIX, OS/2, and Macintosh platforms as well. (<http://www.whatis.com>)

## 2. OLE -DB

Francis(1998), defines OLE-DB as the next step in the evolution of the anonymous data store. It is faster and easier than ODBC, and eventually it may well replace ODBC.

OLE-DB and ODBC are similar, but OLE-DB has a broader range of databases and it can sit on top of ODBC as seen in the below figure.



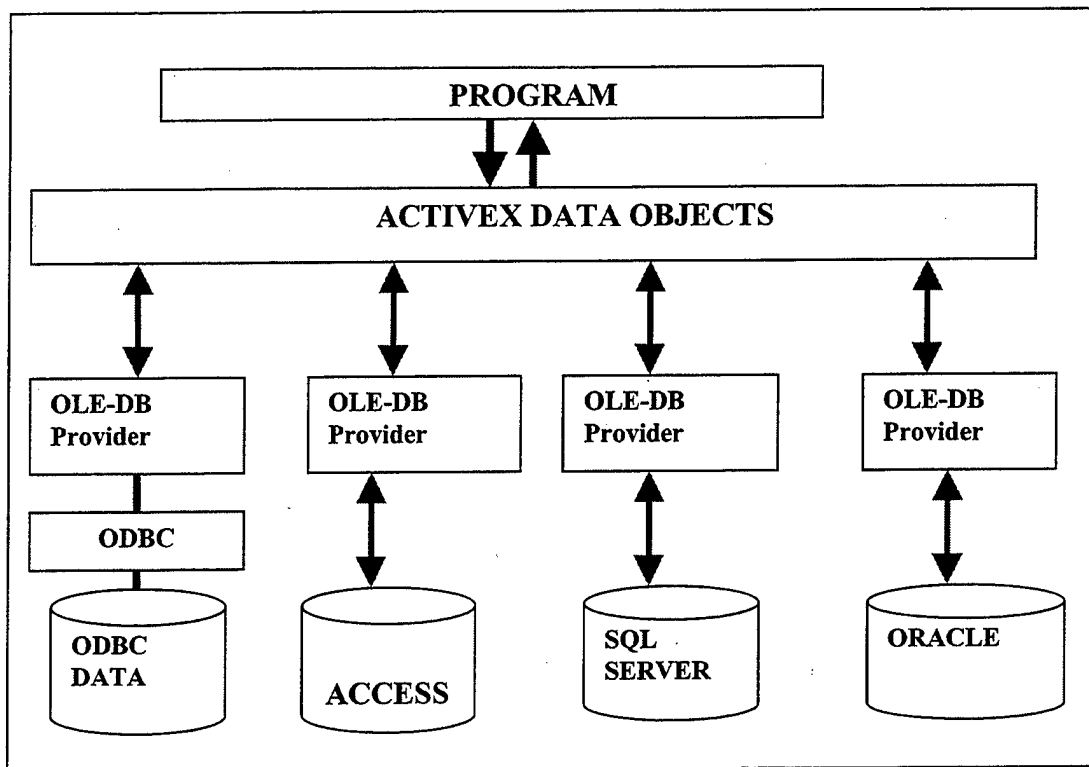


Figure J-4. OLE-DB and ODBC Relation. "From Francis, 1998,pg.407"

Data providers and data consumers are the two new terms that introduced by OLE-DB. Data provider is something that provides data such as Microsoft Access, Microsoft SQL Server and Oracle. Data consumer is something that uses data such as the ASP technology that will be used in this thesis.

Microsoft has defined the term OLE as Object Linking and Embedding, however they claim that it now simply refers to the word OLE.

### 3. ActiveX Data Objects

As seen in figure J-4, ActiveX Data Objects (ADO) is the friendly face of OLE-DB. Therefore you don't need to know anything about OLE-DB, since ADO will hide the

complexity giving a user a simple way of accessing data from any database. ADO is the way we actually get data to and from a database. (Francis, 1998, pg. 408)

ADO enables us to link the users to different databases on our on-line documents. It is simply a group of functions and variables that help us to access databases and manipulate data.

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## APPENDIX K. PLANNING NT DOMAIN

This document is Chapter 1 of the Concepts and Planning book in the online documentation set that is included on the compact disc and is also available in book form. (<http://www.microsoft.com/NTServer/nts/deployment/planguide/DomainPlanGuide.asp>)

### A. DECIDING ON A DOMAIN MODEL

A *domain model* is a grouping of one or more domains with administration and communications links between them (trust relationships) that are arranged for the purpose of user and resource management.

By properly planning and organizing the domains on a network, it is possible to simplify network administration and ensure that all users can connect to available resources through the network. For example, set up your domains so that all user accounts and global groups are valid in all domains.

Because one domain can accommodate up to 26,000 users with individual workstations and approximately 250 groups, a single domain is suitable for most applications. To decide how many domains your organization needs, take into account the workflow structure and number of users. Windows NT Server domain models provide the flexibility needed for different organizations:

- Organizations with many small branch offices
- Large organizations
- Security for sensitive information

In addition, expansion is easy. Offices can start out with separate domains and can link to each other later or can be added to existing domains.

The size of your organization is the first consideration because the size of the directory database determines how many domains are needed.

### B. DIRECTORY DATABASE SIZE

If you are managing a small or medium organization, it is probably not necessary to worry about the upper limits of a Windows NT Server domain. However, if you are planning for significant growth, these numbers should be kept in mind.

The limiting factor of a domain's size is the number of user accounts that can be supported by a single directory database. The maximum allowed size of the directory database file is 40 MB.

A domain consists of user accounts, computer accounts and group accounts, both built-in and those you create. Each computer running Windows NT Workstation or Windows NT Server has a computer account. Each of these objects occupies space in the directory database file. The practical limit for the size of the directory database file depends on the type of computer processor and amount of memory available in the machine being used as the primary domain controller. Microsoft has tested directory database files in excess of 40 MB but recommends 40 MB as the upper limit. Different types of objects require different amounts of space in the directory database file:

Object	Space Used
User account	1.0K
Computer account	0.5K
Group account	4.0K (average group size = 300 members)

For a single domain, here are some examples of how objects might be distributed:

	User Accounts(1K per account)	Computer Accounts (0.5K per account)	Group Accounts (4K per account)	Total Directory Size
1 workstation per user	2,000	2,000	30	3.12 MB
2 workstations per user	5,000	10,000	100	10.4 MB
2 users per workstation	10,000	5,000	150	13.1 MB
1 workstation per user	25,000	25,000	200	38.3 MB
1 workstation per user	26,000	26,000	250	40 MB
1 workstation per user	40,000	0	0	40 MB

Table K-1. NT User Limits

Let's give an example to clarify this table. Suppose that an organization has 100 computers connected to only one NT Server and there are 200 user accounts and 5 group accounts. The total space of the directory database for this domain will be the total of:

Number of computers \* Space used by one computer account  
Number of user accounts \* Space used by one user account  
Number of group accounts \* Space used by one group account

Thus,

100 * 0.5	=	50 K
200 * 1.0	=	200 K
5 * 4	=	20K
Total	=	270K

270 K shows that this single domain uses its 0.675 % (270/40000) of its full capacity.

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## **APPENDIX L. SHARE PERMISSIONS AND NTFS PERMISSIONS**

This document is taken from Windows NT Network Administration, Academic Learning Series, 1998, pg.212

### **A. SHARE PERMISSIONS**

<b>Type of permission</b>	<b>The ability given to users</b>
Full Control	Modify file permissions. Take ownership of files on NTFS volumes. Perform all tasks permitted by the Change and Read permissions.
Change	Create folders and add files. Change data in files. Append data to files. Change file attributes. Delete folders and files. Perform all tasks permitted by the Read permission.
Read	Display folder names and file names. Display the data and attributes of files. Run program files. Access other folders within that folder.
No Access	Establish only a connection to the shared folder. Access to the folder is denied and the contents do not appear. This is the most restrictive permission, and is useful for high security. The No Access permission overrides other permissions.

Table L-1. Share permissions

### **B. NTFS PERMISSIONS**

Windows NT provides six individual NTFS permissions. Each permission specifies the access that a user or group can have to a folder or file.



<b>NTFS Individual Permissions</b>	<b>For a folder, a user can</b>	<b>For a file, a user can</b>
Read ( R)	Display folder names, attributes, owner, and permissions	Display file data, attributes, owner, and permissions.
Write (W)	Add files and folders, change a folder's attributes, and display owner and permissions.	Display owner and permissions, change file attributes, create data in, and append data to, a file.
Execute(X)	Display folder attributes, make changes to folders within a folder, and display owner and permissions	Display file permissions, attributes, and owner. Run a file if it is an executable.
Delete (D)	Delete a folder.	Delete a file.
Change Permission (P)	Change a folder's permission	Change a file's permission.
Take Ownership (O)	Take ownership of a folder.	Take ownership of a file.

Table L-2. NTFS Individual permissions

In order to simplify administrative tasks, standard folders and file permissions are used most of the time instead of individual NTFS Permissions,.

<b>Standard Folder Permissions</b>	<b>Individual permissions on folder</b>	<b>Individual permissions on files</b>
No Access	None	None
List	RX	Not specified
Read	RX	RX
Add	WX	Not specified
Add & Read	RWX	RX
Change	RWXD	RWXD
Full Control	All	All

Table L-3. Standard Folder Permissions

<b>Standard file permission</b>	<b>Individual permission</b>
No Access	None
Read	RX
Change	RWXD
Full Control	All

Table L-4. Standard File Permissions

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